



HARTCROWSER

Earth and Environmental Technologies

*Site Remediation Documentation Report
Source Control Remedial Action
Queen City Farms, Washington*

*Prepared for
Queen City Farms*

J-1264-08

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J-1264-08

January 29, 1987

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Re: Site Remediation Documentation Report
Source Control Remedial Action
Queen City Farms, Washington

Attached are two copies of the Site Remediation Documentation Report for the Source Control Remedial Action at Queen City Farms, Washington. This report provides a summary of the site activities as well as descriptions and data regarding the remedial action.

The report was primarily prepared by Hart Crowser, Inc., Northwest EnviroServices, Inc. (NWES), the overall project manager, provided input on sludge processing and waste disposal. PEI, Inc. prepared the as-built drawings.

A large volume of information and documentation was generated during the course of the project. These materials are available in the project files of Hart Crowser, NWES, and PEI, Inc.



Environmental Protection Agency
January 29, 1987

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Please call if you have any questions.

Sincerely,

HART CROWSER, INC.

MATTHEW G. DALTON
Senior Associate Hydrogeologist

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HARTCROWSER

Earth and Environmental Technologies

***Site Remediation Documentation Report
Source Control Remedial Action
Queen City Farms, Washington***

***Prepared by
Hart Crowser, Inc.
Northwest EnviroServices, Inc.
PEI, Inc.***

***January 30, 1987
J-1264-08***

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SITE REMEDIATION DOCUMENTATION REPORT
SOURCE CONTROL REMEDIAL ACTION
QUEEN CITY FARMS, WASHINGTON

1.0 INTRODUCTION

This report presents a summary of the remediation activities and selected data for the recently completed Source Control Remedial Action at Queen City Farms, Washington. The report was prepared at the request of the Washington State Department of Ecology (Ecology) in a letter dated September 30, 1986. The specific items to be presented in the report were discussed and agreed to in a meeting among representatives of Queen City Farms, Ecology, and Hart Crowser, Inc. on October 7, 1986. This documentation report consists of text and data contained in this volume as well as the "As-Built Plan", 10 sheets that accompany this volume.

The site remediation work was completed in accordance with a work plan prepared by Hart Crowser dated September 27, 1985 which was negotiated and agreed upon with Ecology and the United States Environmental Protection Agency (EPA). The work plan was incorporated into Consent Orders negotiated with each agency. Based on this work plan a preliminary design document was prepared and reviewed by Ecology, EPA, and the Army Corps of Engineers. The Final Design Document, dated July 28, 1986, was subsequently prepared which incorporated the review comments of the respective agencies.

Work started on the site prior to the Final Design Document being approved. These activities were related to site mobilization and pond sludge processing which were outlined in the approved work plan.

The preliminary and final designs are based on hydrogeologic and geotechnical data which were collected at differing times during the project. These data are presented in the following reports:

- o Hart Crowser and Associates, Inc., 1983, Assessment of Hydrogeology and Groundwater Quality, Surficial Aquifer, Queen City Farms, King County, Washington, J-1264-01, dated December 13, 1983.
- o Hart Crowser and Associates, Inc., 1985, Focused Remedial Investigation, Queen City Farms, King County, Washington, J-1264-01, dated February 7, 1985.
- o Hart Crowser, Inc., 1986, Final Design Document, Source Control Remedial Action, Queen City Farms, Washington, J-1264-04 dated July 28, 1986.

A massive amount of information and data has been collected during the course of the work. Selected data are summarized in this report. Additional data, such as daily field reports, manifests, laboratory certificates, etc. are available for review in the project files of Hart Crowser, Inc. and Northwest EnviroServices, Inc.

The information given in this report is organized in the following sections:

Section 2 - Site Subsurface Conditions (including soil quality)

Section 3 - Description of Project Phases and Components

3.2 Project Mobilization

3.3 Sludge Processing and Disposal

3.4 Cover and Drainage System

Appendices (A through G)

Data and text regarding the project mobilization, and sludge processing and disposal were prepared by Northwest EnviroService, Inc. and Hart Crowser, Inc. Data and text regarding the subsurface conditions, and covered drainage system were prepared by Hart Crowser, Inc. with input from PEI,

Inc. (formerly Pool Engineering, Inc.) and Northwest Linings, Inc. (geomembrane test data). The "As-Built Plans" were prepared by PEI, Inc. with input by Hart Crowser, Inc.

This report has been prepared for specific application to the Queen City Farms Site using generally accepted practices for the nature of the work completed. No other warranty, expressed or implied, is made.

2.0 SITE SUBSURFACE CONDITIONS

2.1 General

This section describes the subsurface work accomplished as part of the source control remedial action and the refinements to the known site geologic conditions as a result of further subsurface information. Soil quality data for pond bottom soils and pond boring soils are also presented in this section.

2.2 Exploration Locations and Methods

Additional explorations accomplished during the source control remedial action include drilling of eight monitoring well borings (MW-1 through MW-8), three pond bottom borings (PB-1 through PB-3) and two engineering explorations near the upgradient diversion trench (E-1 and E-2). The borings E-1 and E-2 were drilled to observe the location of till-like soil after relatively clean sand and gravelly sand was encountered during the excavation of the upgradient diversion trench excavation (see Section 3.4.2 of this report).

The borings were accomplished using ODEX or hollow-stem auger drilling techniques. Further information regarding drilling methods and the boring logs are given in Appendix A. The locations of borings are shown on As-Built Sheet 1. Field mapping of the trench excavations was also accomplished and was used in refining the interpretation of the site subsurface conditions.

2.3 Refined Subsurface Conditions

The geologic materials at the site can be generally divided into several geologic units:

- o FILL - Remedial Action Fill (subgrade and cover materials) and Pre-existing Fill
- o RECENT DEPOSIT - Lacustrine Silt, Fine Sand, and Peat
- o RECESSIONAL OUTWASH - Sand and Gravel
- o STRATIFIED GLACIAL DRIFT - Comprised of unstratified, till-like silty sand and gravel and Stratified Deposits of Silt, Sand, and Gravel

The interpretation of the geologic data is based on our field exploration information and is characterized in Geologic Cross Sections on Figures 1 through 4. The locations of the geologic cross sections are shown on As-Built Sheet 1.

Underlying the site is a basal layer of stratified glacial drift comprised of a glacially overridden deposit of unstratified silty sand and gravel and stratified silt, sand, and gravelly sand. This deposit is comprised mostly of the unstratified deposit of slightly silty to silty sand and gravel described as till-like and is characterized as having relatively low permeability. During project activity, local variations in the till-like soil and the occurrence of stratified silt, sand, and gravelly sand were noted within this till-like deposit. Modifications of the upgradient diversion trench, described later in the text, reflected some of these local variations. These variation of the stratified glacial drift surface are depicted on the geologic cross sections. The contouring of the top of the stratified drift layer is presented on As-Built Sheet 1. Variety of soil type within the drift is shown on boring logs in Appendix A.

Overlying the stratified glacial drift is a high permeability glacial recessional outwash deposit. This deposit primary consists of a slightly silty to clean sandy gravel to gravelly sand with layers of sand, sandy silt, and silt. The recessional outwash occurs over most of the site and

varies in thickness from a relatively thin layer of a few feet in the north portion of the site to a 125-foot-thick layer towards the south.

In the western area of the site (near Queen City Lake), a recent deposit of lacustrine silt, fine sand, and peat occurs over the glacial deposits. These deposits are "low area" accumulations associated with the Queen City Lake, up to 16 feet in thickness.

Other site soils include pre-existing site fill materials and fill associated with the site activities including pond backfill, subgrade fill, and cover system fill. A further description of soils used in the remedial action is given later in this text in Section 3.4.

2.4 Soil Quality

Soil samples were obtained during remediation activities in general accordance with Section 3.2.C of the Consent Order issued by Washington State Department of Ecology.

2.4.1 Pond Bottom Soil Samples

Six soil samples were obtained from each pond bottom after sludge had been removed. The soil samples were collected with stainless steel tools and stored on ice in specially cleaned glass jars during transport to the laboratory. At the laboratory, the six soil samples from each pond were composited on an equal mass basis for analysis. Analyses were conducted for priority pollutants and EP toxicity metals. The results of the analyses are summarized in Table 1. The laboratory reports including method references and quality control information are included in Appendix C.

2.4.2 Pond Boring Soil Samples

Soil samples were obtained from borings drilled in the approximate center of each pond after sludge had been removed (borings PB-1, PB-2, and PB-3).

The borings were drilled using hollow-stem auger or ODEX drilling techniques and the samples were collected using a split-spoon sampler. Samples were handled as described for pond bottom soil samples. Three soil samples from each boring were selected for analysis based on material type. Each selected soil sample was analyzed for priority pollutants and EP toxicity metals. The results of the analyses for detectable chemical parameters are summarized in Tables 2, 3, and 4. The laboratory reports including method references and quality control information are included in Appendix C. Boring logs for PB-1, PB-2, and PB-3 are given in Appendix A.

3.0 DESCRIPTION OF PROJECT PHASES AND COMPONENTS

3.1 General

This section describes the phases and components of the remediation work. The remediation work was comprised of:

- o Project Mobilization
- o Sludge Processing and Disposal
- o Installation of Cover and Drainage System

3.2 Project Mobilization

Northwest EnviroService, Inc. (NWES) mobilized for the Queen City Farms Project during the latter part of October 1985. Transportation patterns and equipment patterns (i.e., flow of traffic, equipment, people, and command centers) were laid out. Berms and perimeter roads were established and installed. The project office was established in a house east of the three ponds. A NWES field project trailer was put on site for health and safety, and control purposes.

Clearing of wooded areas began immediately. The excavation and dozing of the working surface pads was initiated. Pit run sand and gravel was brought in to establish a firm working base for asphalt pads.

Asphalt pads were placed parallel to Ponds 1, 2, and 3. These asphalt pads were to be used for: supporting the Super Macs (see Section 3.3) and ancillary support equipment during pond sludge processing; a staging area for material from the Super Macs; and stabilization of sludge prior to going to a Class I disposal site.

Drainage and sump systems were installed to control runoff and collect truck wash water so water would be contained and either directed back into the ponds for reprocessing or to underground tanks through a sump system for later processing. A truck wash area was constructed so the trucks could be washed after they were loaded and before leaving the controlled area. The drainage system was installed at the time the asphalt pads were put in place.

3.3 Sludge Processing and Disposal

3.3.1 Sludge Removal and Initial Processing

Pond sludge was processed by a enclosed mobile phase separator (Super Macs Phaser Series System). Sludge handling by conventional methods such as mechanical excavation was deemed impractical and not cost-effective because of the heterogeneous and oily nature of the sludge. The Super Macs system was originally designed to clean large petroleum storage tanks, barges, and ship bilges. The Super Macs system was adapted to remove the sludge from the ponds and complete the initial step of sludge processing.

The Super Macs was delivered to the site in late January 1986. After a shake down period of several weeks, processing of Pond 1 sludge began, followed by Pond 2 and Pond 3 sludges. Sludge processing was completed in July of 1986.

A pond skipper was an intergral part of the system which transformed the sludge into a slurry. The slurry was then pumped to the Super Macs processing unit. The skipper was approximately 6 feet wide and 12 feet long and had two large augers that perform as wheels to break up and move

sludge to the middle of the skipper. The skipper also receives heated water from the Super Macs (up to 180° F). The heated water flows through jets to help break up the sludge. In the middle of the skipper is a pump which pumps the slurry to the Super Macs processing unit. Another water jet heated as the side of a pond was occasionally used to break up sludge and direct the slurry to the pond skimmer.

To begin sludge processing the Super Macs was loaded with an aqueous 5 percent caustic solution and brought up to temperature (approximately 180° F). The pond skipper/intake structure was then moved into the pond.

The slurry, composed of sludge and heated fluid from the process unit, was pumped to the processing unit where phase separation occurred (creating water, an oily sludge, and solids). Water was recycled back into the pond skimmer after being reheated while organic phases (oily sludge) were pumped to Baker tanks for storage. A relatively small amount of material was produced by the centrifuge portion of the Super Macs during the phase separation process.

The pond skipper was able to remove most of the fluid portions of the sludge from the pond bottoms. Once the pond bottom was attained, mechanical equipment (dozers, clam shell, and drag line) were used to remove the remaining small amount of sludge from the ponds. This equipment was also used to remove the one foot of soil in the pond bottom per the consent order. In Pond 1, a stabilization agent was placed in the pond bottom to make the sludge easier to handle and excavate. This material was not processed in the Super Macs and was disposed of at a Class I disposal site.

In Ponds 2 and 3, the procedure to complete sludge removal was modified. A high pressure jet and dozer was used to direct sludge to the low point in the pond where the pond skipper was located. Once this procedure had been completed, a relatively small amount of pond sludge was mechanically removed and stabilized.

Mechanical excavation and waste removal was completed until at least one foot of soil (beneath the sludge) was removed. A depth of soil greater than one foot was excavated in some areas of the ponds.

3.3.2 Waste Streams - Description, Handling, and Disposal

The site activities produced or resulted in the handling of several wastes. The wastes included:

- o Contaminated wood debris,
- o Water (from sludge processing, equipment decontamination, and collected precipitation runoff),
- o Oily sludge (from pond sludge processing),
- o Pond bottom sludge and soil,
- o Solids and Centrifuge Material (from pond sludge processing),
- o Old drums,
- o Ecology blocks, and
- o Contaminated working surface soils.

Contaminated Wood Debris (tree branches, trunks, and stumps) produced during the clearing and grubbing operations. Wood debris was separated into contaminated or uncontaminated piles. Contaminated wood debris was shipped to the Class I disposal site in Arlington, Oregon.

Water was either recycled through the Super Macs or was collected on-site. Collected water was trucked and treated at the NWES facility on Airport Way in Seattle. Approximately 482,000 gallons were shipped off the site. Waste water chemical test data are summarized in Table 5.

Oily Sludge was produced through the processing of the pond sludge. This material was pumped from the Super Macs to Baker tanks for storage and future stabilizing. Oily sludge was stabilized and transported off-site to the Class I disposal site. Stabilization occurred in a containment area contained by ecology blocks on asphalt pads. Stabilization agent (kiln dust and/or limestone flour) was placed in the containment area and the oily sludge was pumped from the Baker tanks into the stabilization agent. To achieve a material which would meet the "paint filter test" a ratio of stabilizing agent to oily sludge of 1:1 to 3:1 was used. The stabilized oily sludge was then loaded into trucks that were diapered, taped, weighed and washed for transport to the disposal site. Approximately 23,750 tons (including working surface soils, old drums, and contaminated wood debris) were transported off-site. Chemical test data are summarized in Table 6 for the stabilized materials.

Pond Bottom Sludge and Soil that could not be pumped by the pond skipper was removed by mechanical equipment. As discussed earlier the bottom material from Pond 1 was partly stabilized by blowing stabilizing agents into the pond bottom and removing the material with a drag line and clam shell. The bottom material from Pond 1 was further stabilized in the containment area. In Ponds 2 and 3 the bottom materials were mechanically removed using a clam shell, were stabilized and loaded onto trucks in a similar manner as the oily sludge. All pond bottom materials were stabilized in the same manner as the oily sludge. This material is accounted for in the stabilized oily sludge volumes presented above.

Solid and Centrifuge Material were produced by the Super Macs. Solid material represents gravel-size or larger material retained on a shaker screen. The solid material was collected and placed directly in the stabilized material pile. The centrifuge material represents a viscous material that would pass the paint filter test. The centrifuge material was collected in drop boxes and eventually placed in the stabilized material pile. Both the solid and centrifuge material were shipped with the stabilized material to the Class I disposal site.

Old Drums were encountered in the pond bottoms and banks, and within the working surface soils. Approximately 500 to 700 drums were separated, crushed, loaded onto trucks, and transported to the Class I disposal site.

Ecology Blocks remaining from the clean-up process were decontaminated and stored off-site. Eleven ecology blocks were placed in Pond 3. These ecology blocks were aligned along the north and west edges of the bottom of the pond.

Contaminated Working Surface Soils excavated south of Ponds 1, 2, and 3 were placed in Ponds 2 and 3. Some deeper working surface soils south of Ponds 1, 2, and 3 remained in place as did some working surface soils east of Pond 1. Some portions of working surface soils were shipped off-site to the Class I disposal site. Those soils shipped off-site were either excavated with the old drums or encountered during subgrade excavation at the east toe drain (between borings HC-18 and HC-19).

3.4 Cover and Drainage System

3.4.1 General Description

For the purposes of this report, the cover and drainage system refers to the following elements of the site remediation:

- o Upgradient diversion system,
- o Cover subgrades,
- o Silt cover,
- o Geomembrane,
- o Cover soil layers (excluding silt),
- o Silt berm,
- o Erosion control,
- o Cover drainage system,
- o Monitoring well system.

The cover and drainage system installation was in accordance with the Final Design Document dated July 28, 1986. The Final Design Document consisted of Technical Specifications and Plans (nine sheets). The following discussion of the installation of the cover drainage system will focus on quality assurance data and on variations from the Final Design Document. previous technical specifications are also provided for reference with this As-Built Plan documents (10 sheets) are provided with this report. The report in Appendix G. Modifications to the Final Design Document as established during the remediation work are given in Appendix F.

3.4.2 Upgradient Diversion System

Installation of the upgradient diversion system is described by Technical Specification Section 2.04 (F and G), portions of 3.02 and 3.03 (A and C), and portions of Plan Sheets 2, 3, 4, 7, and 8. The upgradient diversion system consisted of a vertical 4-foot-deep excavation, various geotextiles, a geomembrane, perforated and solid pipe, bedding and backfill, manholes and a cleanout. Installation was in accordance with the specifications and plans except as noted in this section.

Excavation for the trench was revised between Manhole 1 and Manhole 3 and between Manhole 1 and the outfall. This revision was accomplished due to variations in top of till-like soils between Manhole 1 and Manhole 2 (i.e., the top of till-like soils was lower than the top of trench elevations). Two borings, E-1 and E-2, were accomplished to observe the till-like soils surface. The elevations of the top of the trench and trench bottom between Manhole 1 and Manhole 2 were subsequently lowered by 4 feet. The elevations at the outfall and Manhole 3 were held constant resulting in small changes in grade. The final diversion trench profile is shown on As-Built, Sheet 4.

The excavated trench wall and base within till-like soils was rougher than anticipated in design. While it was not considered a problem by the geomembrane installer, a woven geotextile (Permea-Tex 2500) was placed against the excavated trench surface from the silt dam to the cleanout.

The woven geotextile was intended to "bridge" the roughness and provide additional support for the geomembrane.

During excavation of the trench between station 1+89 and 2+39, a relatively clean, sand or gravelly sand was encountered in the trench side walls and bottom beneath the till-like soil layer. The sand or gravelly sand occurred in the side walls and occasionally the base of the trench between the above stations. A short section of 18-foot-wide geomembrane (30 mil reinforced vinyl membrane "XR-5") was placed in the trench between stations 1+84.5 and 2+60.5 to span the sand and gravelly sand areas in the trench (see As-Built Sheets 7 and 8). This geomembrane was continued to the top of the trench and was "keyed" into till-like soils at the base of the trench with compacted silt at station 1+84.5.

The construction of a 9- to 12-inch-thick hand-compacted silt blanket from stations 4+30 to 5+50 and 9- to 12-inch-thick by 12-inch-wide hand-compacted silt "fingers" were accomplished at various locations along the upgradient edge of the trench (see As-Built Sheet 7). These features were constructed to limit drainage along the bench and promote flow into the trench.

The geomembrane and geotextiles were terminated in a 12-inch-wide by 12-inch-deep key trench at the silt dam (station 1+76, see As-Built Sheet 8).

The quality assurance and quality control work at the trench was comprised of checking of excavated trench configuration, grades and elevations, material delivery and placement, and bedding and trench backfill soils. Some materials used in the trench were generically specified in the Final Design Document. Those materials are listed below with their specific product references.

Cushioning Geotextile (non-woven) - Phillips Petroleum 10-NP

(10 ounces per square yard weight)

Filtering Geotextile (Woven) - Nicolon 40/30A

Geomembrane - BF Goodrich PVC (30 mil thickness) See Section 3.4.5

Grain size distribution laboratory tests were accomplished on the pea gravel backfill and bedding sand. The results of those tests are given in Appendix B. The pea gravel and sand met specifications based on these laboratory tests.

3.4.3 Cover Subgrades

The placement of subgrade materials for the final cover is described by Technical Specifications 2.02 (B, C, F, and G) and 2.04 (A and B) and Plan Sheets 3, 5, 6, and portions of 7 and 8. Placement of subgraded materials was in accordance with the specification and plans.

All soil materials utilized were within the specifications. Soil materials used in the subgrade and pond filling are:

- o Excavated site soils (consisting of sand and gravel, and till-like silty sand and gravel);
- o Imported silty sand and gravel, and relatively clean sand and gravel (grain size distribution laboratory test results are given in Appendix B); and
- o Working surface soils (see Section 3.3.2).

Other materials were also placed in the Pond 3 excavation including asphalt, gravel subgrade beneath the asphalt, and 11 concrete "ecology blocks" (see Section 3.3.2). The asphalt and gravel were placed in the bottom of Pond 3 excavation. The asphalt pieces were placed as required by the specifications (i.e., the pieces were small and were scattered within the soil).

Soils were placed in the pond excavations with dozers in lifts one to two feet in loose thickness. Compaction of each lift was performed by several passes of 7 and 10-ton smooth-drum vibratory rollers to a firm, non-yielding surface. The final subgrade surface was proof-rolled to a firm, non-yielding condition by the same rollers.

3.4.4 Silt Cover and Silt Berm

The silt cover installation is described by Technical Specification Sections 2.02(A) and 2.04(C) and Plan Sheets 5, 6, and portions of 7 and 8. Quality assurance and quality control (QA/QC) work specific to the silt cover is described in Section 6.03 of the Technical Specifications. Silt cover installation was in accordance with specifications and plans. As-Built Sheet 10 includes the final elevations of the silt cover. Some portions of the specifications (i.e., silt compaction and grain size criteria) were modified during installation. These modifications and other exceptions to the plans and specifications regarding the silt cover are discussed below.

All silt soils were derived from SR-90 construction in Seattle or Mercer Island, Washington. Three types of silt were utilized. The original placement criteria for silts included compaction to 100 percent of maximum dry density as determined by the standard Proctor method (ASTM D 698) with a compacted water content at least 2 percent greater than optimum water content (as defined by the standard Proctor maximum dry density).

This criteria was modified to some degree for each silt type. The criteria for placement was intended to provide a value of saturated hydraulic conductivity of 1×10^{-6} centimeters per second or less.

The silt was placed in 6- to 8-inch-thick loose lifts and compacted with a variety of compactors including self propelled 7- to 10-ton vibratory smooth drum roller, small tow-type vibratory roller (padded and smooth drum), and a 10-ton self-propelled pad foot, dual drum roller. The number of passes of each roller was varied as required to achieve requisite dry

density. Occasional applications of water to compacted silt surfaces were accomplished in order to limit drying. A small area of silt damaged by desiccation cracking on the 5H:1V at the eastern portion of the silt cover was removed. Areas of silt loosened and saturated by rainfall were also removed.

Hand-compaction of silt using pneumatic tampers was accomplished at monitoring wells, geomembrane key trenches, near the edge of the diversion trench and at the silt dam, fingers, and blanket.

Prior to geomembrane installation, the entire completed silt cover layer was rolled with a smooth-drum compactor. The placement of silt is discussed below for each of three types of silt. Criteria for placement specific to each material type are included.

o Type I Silt

Type I silt was obtained from SR-90 construction activities in Seattle, Washington from the Kiewit Construction Company. The silt properties are summarized in Table 7. Data obtained as a result of field QA/QC work are included in Table 7. Essentially the Type I silt had two subgroups - those silts with a plasticity index (PI) near 40 and those silts with a plasticity index (PI) near 30, both of which exceeded specifications. Both silts had on the order of 85 to 100 percent fines (material passing the U.S. No. 200 sieve).

The laboratory moisture-density relationships for Type I silts are given in Table 7 and on Figure B-11 (Appendix B). Two hydraulic conductivity tests were performed on Type I silts (results are also shown on Figure B-11). Based on these two hydraulic conductivity tests, the criteria of placement were modified to allow a lower dry density for water contents 5 percent or more than optimum water content. The criteria are summarized below.

Natural Moisture Content
(with respect to optimum)
in Percent

Requisite Percent of
Maximum Dry Density

+2 to 5

+5 or more

100 (original criteria)

95

This revision to the placement criteria was discussed during the course of the project as documented in Field Modification No. 9 (see Appendix F).

An estimated total of 5,500 cubic yards in-place of Type I material were placed with a total of 42 in-place drive ring density tests performed. A large percentage of Type I silt represented soil with a PI near 40. All but five tests indicated a dry density equal to or greater than that required (areas represented by the five failed tests were either recompacted to minimum criteria or excavated and replaced).

The silt berm was constructed solely of the Type I silt. A portion of the volume and number of in-place density tests relate to the silt berm. The extent of silt placed in the silt berm was greater than in the plans and was increased to limit subsurface ponding of water (see As-Built Sheet 7). Discussion of the sand and gravel placed in the silt berm is given in Section 3.4.8.

A small volume of Type I silt was also used at the silt dam at the upgradient diversion trench.

o Type II Silt

Type II silt was obtained from SR-90 construction activities on Mercer Island, Washington from Fiorito Brothers and Scarsella Brothers construction companies. The silt properties are summarized in Table 7. Data obtained as a result of field QA/QC are included in Table 7. The Type II silt had a plasticity index ranging from 4 to 10 (with one test of 3 and 14 each), which met the specifications. The percent fines was generally between 54 to 71 percent as compared to minimum percent fines of 70 percent

in the specifications (with three tests less and two tests greater than that range). The minimum percent fines was modified to allow use of the Type II silt prior to placement on the basis of laboratory hydraulic conductivity tests and moisture-density relationships.

The laboratory moisture-density relationships for Type II silts are given in Table 7 and on Figures B-12 and B-13 (Appendix B). The results of four hydraulic conductivity tests are also shown on Figures B-12 and B-13. The percent fines of Type II silts varied as previously mentioned. In order to determine the maximum dry density for a given percent fines, a correlative plot of percent fines versus laboratory maximum dry density was prepared from the six laboratory moisture-density relationships for the Type II silt (the plot is given on Figure B-14 in Appendix B). Based on these tests, the criteria of placement was varied depending on the percent fines in the silt to provide a minimum saturated hydraulic conductivity of 1×10^{-6} centimeters per second. The revisions to the minimum percent fines and the placement criteria were discussed during the course of the project as documented in Field Modification No. 9 (see Appendix F).

<u>Percent Fines</u>	<u>Requisite Percent of Maximum Dry Density</u>
50 to 60	95
greater than 60	100

The natural water content of the Type II silt was at or slightly above optimum water content. The minimum in-place water content was revised to optimum water content based on the results of the hydraulic conductivity tests.

An estimated volume of 11,000 cubic yards of Type II silt was placed with a total of 69 in-place density tests. Field determinations of the percent fines on Figure B-14. These density tests utilized a rubber-balloon densometer. All but 19 tests indicated a dry density equal to or greater than that required. Of the areas represented by those 19 tests, nine areas

were recompacted to requisite dry density, three areas were removed and replaced, and the remainder were left in-place and covered by an additional 2 feet thickness of silt. The areas left in-place were along the 3H:1V slope towards the upgradient diversion trench. A portion of the surface left in-place (3H:1V slope between MH 2 and 3) was treated with kiln dust to provide a more dense surface for subsequent silt placement and compaction.

o Type III Silt

Type III silt was obtained from SR-90 construction activities on Mercer Island, Washington from Fiorito Brothers construction company. A small volume of this material was utilized for a duration of one day. The silt properties are summarized in Table 7. The Type III silt had a plasticity index of 19 to 22 and percent fines of 95.

The laboratory moisture-density relationships for Type III silts are given in Table 7 and on Figure B-15 (Appendix B). Based on soil property similarities to Type I silt, the compaction criteria for Type I silt was utilized for Type III as well. The estimated in-place volume of Type III silt is 700 cubic yards. A total of four in-place density tests were performed with an in-place dry density equal to or greater than required.

3.4.5 Geomembrane

Installation of the geomembrane is described by Technical Specifications Sections 2.03(A), 2.04(D), Appendix B (of the Technical Specifications), and Plan Sheet 2, and portions of 7 and 8. Quality control and quality assurance work is described in Technical Specification Sections 6.04 and 6.05. Installation was in accordance with specifications and plans. As-built Sheet 10 includes the final elevations and extent of the geomembrane. Copies of contracts and warranties with the geomembrane subcontractor are available for review at Northwest EnviroServices, Inc. offices.

A 30 mil nominal thickness PVC geomembrane manufactured by BF Goodrich Company was selected for this project. Five-foot-wide strips of PVC were fabricated at the factory to 20- to 90-foot-wide by 200- to 300-foot-long panels by Staff Industries, Inc. Eleven panels were delivered to the project site. The PVC was manufactured and fabricated in accordance with NSF Standard 54. Quality control test data regarding these properties are given in Appendix D and include BF Goodrich material test data and Staff Industries tests on factory seams. All data meet the specifications for this project.

The panels were individually packaged and delivered to the site. The location of each panel is shown on As-Built Sheet 10. Prior to geomembrane installation, a representative of the installer (Northwest Linings and Geotextile Products, Inc.) observed the prepared silt surface. Defects observed in the silt surface were repaired prior to geomembrane installation. Geomembrane field seams were accomplished utilizing an approximate 3-inch-wide overlap, a glue board, roller, and a vinyl adhesive. On cool days, the geomembrane was warmed with a heat gun prior to gluing. Quality control/quality assurance activities included:

- o Visual observation and "pick-testing" of each field seam,
- o Visual observation of entire geomembrane,
- o Air Lance testing of each field seam (40 pounds per square inch air pressure),
- o Removal of geomembrane field seam sections for destructive testing,
- o Full-scale test section.

Visual observation indicated defects in the geomembrane as supplied as discussed below. A small hole in panel B, a glued wrinkle in panel I and poorly-glued 20-foot length of four factory seams at the east end of panel I were observed and repaired.

Visual observation of field seams indicated occasional fish mouths, bubbles, and poorly-glued seams. Fish mouths and poorly glued seams were

reglued. Bubbles were repaired with a patch. A summary of those repairs is given in Table 8.

Wrinkles within the geomembrane sheet of various sizes were occasionally produced during the placement operation. The wrinkles were between 0.1 to 0.2 feet in height, did not occur at seams, and were not deemed a potential problem. As a precautionary measure, the larger wrinkles (generally over 0.2 feet in height) were either laid flat and glued or cut out and seam glued with an end patch. A wrinkle repair was made at all panels except panels A, B, and C.

A total of 17 locations were selected for destructive testing of field seams. At those locations, a 1- to 2-foot square section of geomembrane was removed and submitted to a testing laboratory. Each geomembrane section was divided into several samples and subjected to peel and tensile (bonded seam strength) tests. Only one failing test of a total of 97 tests occurred (a peel test on seam H-G). Individual test data are given in Appendix D. The frequency of test locations were:

- o 1 each seam within upgradient diversion trench,
- o 1 each 10,600 square feet of cover.

The specifications required one test each 100 lineal feet of trench and one test each 5,000 square feet of cover. This frequency of testing was developed without knowledge of the contractor's selected panel size. At this project, only two field seams were produced in the trench; a sample was obtained of each seam. One and in some cases two samples were produced from each major field seam (only one major field seam, I-K, did not have a sample prepared). In other words, the frequency of tests given in the specifications was modified to represent the nature of the panel size, installation methods (i.e., one crew per seam), and the passing test results.

A 10-foot square test section was accomplished in accordance with the specifications. The location of this test section is shown on As-Built

Sheet 10. This location was chosen to provide a representative silt surface, to include a factory and field seam, and to include several small wrinkles. A Caterpillar D-6 bulldozer was utilized to place two feet of sand and two feet of cobbles over the geomembrane. Several passes of loaded trucks occurred at the test section prior to excavation of the cobbles and sand. Visual observation of the geomembrane surface after excavation of sand and cobbles indicated flattened but undamaged wrinkles and undamaged factory and field seams. A small cut into the geomembrane was produced by a shovel during the excavation and was subsequently repaired. Airlance and pick testing was done on the exposed field and factory seams. No defects were observed.

Geomembrane boots were provided at each monitoring well and sealed to the 8-inch-diameter protective well casing with stainless steel bands and vinyl adhesive. A geomembrane boot was also provided for the diversion trench pipe and the cover drain outfall. The boot for the cover drain outfall represents a design revision intended to improve the performance of the cover drainage system.

3.4.6 Sand Layer

A 2-foot-thick layer of sand was placed directly over the geomembrane. Installation of the sand layer is described by Technical Specifications sections 2.02(B) and 2.04(E) and Plan Sheets 5, 6, and portions of 7 and 8. Installation was in accordance with the specifications and plans.

The sand was obtained from two commercial sources and an on-site borrow area. The grain size distribution was within the specification for all sources, except for a small volume of sand placed above the diversion trench between Manhole 1 and Manhole 2. Ten laboratory grain size distribution tests were performed on the sand. Results of these tests are given on Figures B-7 and B-8.

The sand was placed utilizing Caterpillar D-6 and D-8 bulldozers. The bulldozers operated on a blanket of sand no less than 2 feet thick. The

thickness of the sand placed was observed using 30-inch-high "traffic cones". The thickness of the sand was greater than two feet.

3.4.7 Cobble Layer

A 2-foot-thick layer of cobbles was placed directly over the sand layer. Placement of the cobbles is described by Technical Specifications sections 2.02(D) and 2.04(E) and Plan Sheets 5, 6, and portions of 7 and 8. Cobble layer installation was in accordance with the specifications and plans.

The cobbles were obtained from three commercial sources. The cobbles were visually observed and classified with respect to the specifications and were within the specification criteria.

The cobbles were placed utilizing Caterpillar D-6 and D-8 bulldozers. The thickness of the cobbles was observed using 30-inch-high "traffic cones". The thickness of the cobbles was greater than two feet.

3.4.8 Sand and Gravel/Silty Sand and Gravel Layers

Layers of 6 inches of silty sand and gravel and 6 inches of sand and gravel were placed over the cobble layer. Placement of these layers is described by Technical Specifications sections 2.02(C) and 2.04(E) and Plan Sheets 5, 6, and portions of 7 and 8. Placement was in accordance with the specifications and plans with the following exceptions.

The Plans and Technical Specifications include a 6-inch-thick layer of sand and gravel over the cobbles. The sand and gravel as specified could contain as much as 12 percent fines. The source of this material was on-site and included 12 to 16 percent fines. It was concluded that this material met the intent of the specifications. An additional layer of relatively clean, sand and gravel was placed between the upper sand and gravel containing fines (termed the "silty sand and gravel" for this report) and the cobbles. Relatively clean sand and gravel was added to limit the migration of fines into the cobbles. Five laboratory grain size

distribution tests were performed on each material and are given on Figures B-9 and B-10.

Both layers were placed using bulldozers. The thickness of each 6-inch layer was visually observed and varied between 6 and 12 inches.

Some sand and gravel was placed as part of the silt berm. A laboratory moisture-density relationship for the sand and gravel was accomplished and is given on Figure B-16. The field in-place density of the sand and gravel at the silt berm exceeded the minimum required by the Technical Specifications on the basis of two tests.

3.4.9 Erosion Control

The erosion control measures included hydroseeding and placement of rock riprap and spalls. Implementation of these measures is described by Technical Specifications 4.02, 4.03, and Appendix C (of the Technical Specifications) and Plan Sheets 2, 4, and portions of 7. Completion of these measures was in general accordance with the specifications and plans.

The hydroseeding was performed by Grass Master. The hydroseed application, including seeding, fertilization and mulching rates, were provided by Grass Master (see Appendix E for data).

Two phases of hydroseeding were done at the site. The first phase, completed at the end of September 1986 included the 1½:1 cut slope of the upgradient diversion trench and the area near the diversion trench outfall. The second phase was completed by the first of November 1986 including the cover area and remaining disturbed cut and fill areas around the site.

The seed was a Grass Master erosion-control seed mix, provided by D-F Marks Company. The fertilizer consisted of a pelleted mixture of 16-16-16 nitrogen, phosphoric acid, and potash. The mulch was a Weyerhaeuser wood

cellulose "Silva Fiber". The materials were mixed with water in a large tank truck and applied by a power sprayer.

Rock riprap blanket and rock spall blankets were constructed at the diversion trench, cover drain outfall, and grate inlet as shown on As-Built Sheet 2. The exception is the location of the 21-inch half culvert which is discussed in the following section on cover drainage system. Additional rock spalls were placed around the catch basins, ends of the half culverts, and at a location along the south and west cover toe area, to provide temporary erosion control until establishment of the grass cover.

3.4.10 Cover Drainage System

The cover drainage system consists of the following elements:

- o Central cover drain system and grate inlet,
- o West toe drain system,
- o East toe drain system, and
- o Half culverts.

The cover drainage system installation is described by Technical Specifications sections 2.04H, 3.02, 3.03, Figure 1, and Plan Sheets 2, 5, 6, 7, 8, and 9. Installation was in accordance with the specifications and plans.

The materials utilized for the cover drain system were as described in the Technical Specifications, except as follows:

- o Catch Basin Type 1 Design B was used for CB-1, CB-2, and CB-3 instead of the specified Grate Inlet Type 2 of Washington State Department of Transportation Standard Plan B-4C.
- o The termination of the 21-inch half culvert along the toe of the 1½:1 slope was revised to the location of the outfall for the upgradient diversion system. The upper forty lineal feet of 21-inch upgradient

half culvert was changed to 16-inch half culvert pipe between stations 5+55 to 5+95.

- o The 13 percent slope of the 8-inch SDR-35 PVC outfall pipe of the central cover drain was changed to 8 percent slope and 12-inch DR-18 PVC pipe.
- o The cleanout connections of the corrugated, perforated pipe was modified from silicone sealant caulk between pipes to butyl rubber sealant between pipes, and stainless steel band around outside of perforated pipes (see As-Built Sheet 9).

The drain system cleanouts were tested for the upgradient diversion system, east toe drain, and the central cover drain system. Approximately 100 to 500 gallons of water was pumped from a tank truck into each of the drain system cleanouts. Water flow observed at each pipe outfall was generally clean with the expected volume flow. The flow from the north perforated pipe of the Grate Inlet was first observed to have silty flow but the flow was later relatively clean. This silt was probably a result of the dewatering activity around the Grate Inlet at the time of the grout channeling, and not an indication of an improperly functioning pipe.


3.4.11 Monitoring Well System

Installation of the monitoring wells are described by Technical Specifications section 2.04D, 5, Figure 2, and Plan Sheets 1, 2, and 8. Installation was in accordance with the specification and plans.

The specifications called for the use of an existing well HC-1 and installation of seven additional wells. Because of excavation disturbance, a new monitoring well was installed to replace HC-1. The eight monitoring well locations are shown on As-Built Sheet 1. Three monitoring wells were installed upgradient of the cover system, and five were located in the cover area. The monitoring wells were installed prior to completion of the cover system, and the boring log reflects the ground surface at the time of

installation (see Boring Log MW-1 through MW-8 in Appendix A). The subsurface soil conditions were observed by soil sampling during drilling for installation of the monitoring wells. Each boring was screened at the contact of a lower permeability soil strata and backfilled with sand pack and bentonite slurry seal. During installation of the cover system, additional sections of stainless steel well riser pipe and outside PVC protective casing were used to bring the monitoring wells to grade.


The following individuals have participated in the preparation of this report. Please feel free to call if you have questions.



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TABLE 1: RESULTS OF CHEMICAL ANALYSIS, POND BOTTOM SOIL

ANALYTE	POND 1	POND 2	POND 3
Total solids (percent)	77.9	81.3	80.2
METALS, TOTAL (mg/kg)			
Arsenic	2.9	24	1.7
Barium	80	66	29
Beryllium	ND	0.3	0.4
Cadmium	17	3.8	8.3
Chromium	31000	15000	2800
Copper	460	170	58
Lead	20	72	8
Mercury	0.3	0.3	ND
Nickel	54	37	36
Silver	0.6	0.5	0.6
Zinc	91	54	50
METALS, EXTRACTABLE (mg/l) (EP TOXICITY METHOD)			
Barium	ND	0.1	0.2
Cadmium	ND	0.06	ND
Chromium	1.7	5.5	ND
Copper	ND	0.6	ND
Lead	ND	0.1	0.1
Mercury	ND	0.042	ND
Nickel	ND	0.3	ND
Zinc	0.1	0.4	0.2
OTHER INORGANICS (mg/kg)			
Cyanide, total	38	14	1.2
ORGANICS, VOLATILE (mg/kg)			
Methylene chloride	180	36	ND
Acetone	1.9	18	ND
Chloroform	0.29	ND	ND
1,1,1-trichloroethane	1.5	ND	ND
Trans-1,2-dichloroethene	1.3	ND	ND
Trichloroethene	270	670	T
Tetrachloroethene	1.9	ND	ND
1,2-dichloropropane	0.19	ND	ND
Benzene	0.38	ND	ND
Toluene	40	23	22

TABLE 1, CONTINUED

ORGANICS, VOLATILE (mg/kg)

Ethylbenzene	6.2	T	5.6
Styrene	ND	T	ND
Xylene (all isomers)	38	24	30
Vinyl chloride	T	ND	ND
1,1-dichloroethylene	0.049	ND	ND
1,1-dichloroethane	0.038	ND	ND
2-butanone	0.15	ND	ND
1,2-dichloroethane	0.043	ND	ND

ORGANICS, SOLVENT EXTRACTABLE (mg/kg)

Phenol	ND	7.4	ND
2,4-dimethylphenol	8.1	ND	ND
Naphthalene	ND	37	3
Acenaphthene	3.7	11	5.6
Fluorene	5.8	8	8.1
Phenanthrene	33	46	28
Anthracene	ND	8.4	4.8
Fluoranthrene	ND	ND	2.2
Pyrene	7.9	9.8	8.5
Chrysene	4.5	6.5	ND
Bis(2-ethylhexyl)phthalate	ND	5.2	3.3
Benzo(a)pyrene	ND	ND	2.8
Dibenzofuran	ND	4.4	ND
2-methylnaphthalene	63	190	ND
Beta-BHC	ND	ND	0.092
PCB 1254	4.9	10.7	ND
PCB 1260	4.7	4.6	2.2

NOTES:

ND indicates analyte not detected. See laboratory reports for detection limits.

T indicates unquantifiable trace of analyte detected. See laboratory reports for further information.

Data provided by Laucks Testing Laboratories and were compiled by Hart Crowser, Inc.

TABLE 2: RESULTS OF CHEMICAL ANALYSIS, POND BORING PB-1 SOIL

ANALYTE	S-3	S-5	S-6
Depth (feet)	13.5-15.0	23.5-25.0	28.5-30.0
Total solids (percent)	86	87.4	88.3
METALS, TOTAL (mg/kg)			
Arsenic	1.4	3.2	2.3
Barium	51	110	71
Beryllium	0.4	0.8	0.4
Cadmium	38	3.6	2.1
Chromium	7400	1600	1000
Copper	350	110	68
Lead	8	23	6
Nickel	89	46	29
Silver	0.2	ND	ND
Zinc	170	75	65
METALS, EXTRACTABLE (mg/l) (EP TOXICITY METHOD)			
Barium	0.1	0.1	0.1
Cadmium	0.01	ND	ND
Chromium	0.4	ND	ND
Zinc	0.01	ND	0.1
OTHER INORGANICS (mg/kg)			
Cyanide, total	3.3	ND	ND
ORGANICS, VOLATILE (mg/kg)			
Methylene chloride	T	T	4.6
Acetone	T	2.8	2.7
Trans-1,2-dichloroethene	T	ND	ND
Trichloroethene	18	ND	ND
Toluene	3.6	ND	ND
Ethylbenzene	ND	ND	T
Xylene (all isomers)	T	T	ND
2-butanone	ND	5.7	6.1

TABLE 2, CONTINUED

ORGANICS, SOLVENT EXTRACTABLE (mg/kg)

Phenol	8.9	ND	ND
4-methylphenol	2.1	ND	ND
Naphthalene	6.5	1.9	2.2
Acenaphthene	3.7	0.9	0.53
Fluorene	2.8	1.2	0.85
Phenanthrene	12	4.2	2.2
Anthracene	2.8	0.91	0.45
Dibutylphthalate	ND	0.59	0.86
Fluoranthrene	ND	0.24	ND
Pyrene	2.9	0.46	ND
Benzo(a)anthracene	ND	0.37	ND
Chrysene	ND	0.57	ND
Bis(2-ethylhexyl)phthalate	ND	7.2	0.76
Di-n-octyl phthalate	ND	0.69	0.14
Benzo(a)pyrene	ND	0.3	ND
Dibenzofuran	ND	0.28	0.16
2-methylnaphthalene	ND	14	7.8
PCB 1242	3.9	ND	ND
PCB 1254	ND	1.5	0.85

NOTES:

ND indicates analyte not detected. See laboratory reports for detection limits.

T indicates unquantifiable trace of analyte detected. See laboratory reports for further information.

Data provided by Laucks Testing Laboratories and were compiled by Hart Crowser, Inc.

TABLE 3: RESULTS OF CHEMICAL ANALYSIS, POND BORING PB-2 SOIL

ANALYTE	S-1	S-3	S-4
Depth (feet)	4.0-5.5	14.0-15.5	19.0-19.8
Total solids (percent)	75.2	88.4	90.2
METALS, TOTAL (mg/kg)			
Arsenic	2.3	2.4	5.3
Barium	170	63	66
Beryllium	0.6	0.4	0.4
Cadmium	1.5	1.6	1.3
Chromium	6700	820	540
Copper	120	23	47
Lead	12	8	8
Nickel	48	22	23
Silver	0.3	ND	ND
Zinc	57	50	32
METALS, EXTRACTABLE (mg/l) (EP TOXICITY METHOD)			
Barium	ND	ND	0.1
Chromium	2.3	ND	ND
OTHER ORGANICS (mg/kg)			
Cyanide, total	0.6	ND	ND
ORGANICS, VOLATILE (mg/kg)			
Methylene chloride	2.9	0.049	0.07
Acetone	T	0.44	0.59
Toluene	T	ND	ND
Xylene (all isomers)	T	ND	ND
2-butanone	8.7	ND	ND

TABLE 3, CONTINUED

ORGANICS, SOLVENT EXTRACTABLE (mg/kg)

Phenol	0.19	ND	ND
Naphthalene	0.44	ND	ND
Fluorene	0.052	ND	ND
Phenanthrene	0.8	ND	ND
Dibutylphthalate	0.077	ND	ND
Chrysene	0.07	ND	ND
Bis(2-ethylhexyl)phthalate	0.16	0.17	5.4
Dibenzofuran	0.082	ND	ND
2-methylnaphthalene	3.3	ND	ND
PCB 1254	1.1	ND	ND

NOTES:

ND indicates analyte not detected. See laboratory reports for detection limits.

T indicates unquantifiable trace of analyte detected. See laboratory reports for further information.

Data provided by Laucks Testing Laboratories and were compiled by Hart Crowser, Inc.

TABLE 4: RESULTS OF CHEMICAL ANALYSIS, POND BORING PB-3 SOIL

ANALYTE	S-1	S-2	S-11
Depth (feet)	3.0-4.5	5.0-6.5	27.5-28.3
Total solids (percent)	73.1	68.7	93.1
METALS, TOTAL (mg/kg)			
Arsenic	1.1	1.1	2.1
Barium	110	80	37
Beryllium	0.4	0.7	0.4
Cadmium	0.8	1.6	ND
Chromium	1400	1400	22
Copper	180	81	14
Lead	4	6	4
Nickel	34	36	17
Selenium	0.6	0.6	ND
Silver	0.8	0.8	2.9
Zinc	53	62	28
METALS, EXTRACTABLE (mg/l) (EP TOXICITY METHOD)			
Barium	0.1	0.1	0.1
ORGANICS, VOLATILE (mg/kg)			
Acetone	0.24	0.11	ND
Trans-1,2-dichloroethylene	T	T	ND
Trichloroethene	T	T	ND
4-methyl-2-pentanone	0.031	ND	ND

TABLE 4, CONTINUED

ORGANICS, SOLVENT EXTRACTABLE (mg/kg)

Phenol	2.9	ND	ND
Phenanthrene	ND	0.08	ND
Dibutylphthalate	ND	0.06	ND
Bis(2-ethylhexyl)phthalate	0.17	0.13	1.5
Di-n-octyl phthalate	ND	ND	0.1
Benzoic acid	ND	0.36	ND

NOTES:

ND indicates analyte not detected. See laboratory reports for detection limits.

T indicates unquantifiable trace of analyte detected. See laboratory reports for further information.

Data provided by Laucks Testing Laboratories and were compiled by Hart Crowser, Inc.

Table 5 - Chemical Test Data of Waste Water

<u>Test</u>	<u>Average Results</u>	<u>Range of Results</u>
pH	6.60	6.50 to 6.80
Cd (cadmium)	L/0.01 mg/L	L/0.01 mg/L
Cr (chromium)	0.44 mg/L	0.09 to 0.79 mg/L
Cu (copper)	0.15 mg/L	0.04 to 0.32 mg/L
Ni (nickel)	0.05 mg/L	L/0.03 to 0.11 mg/L
Pb (lead)	0.13 mg/L	L/0.1 to 0.25 mg/L
Zn (zinc)	0.26 mg/L	0.12 to 0.40 mg/L

L/ - indicates less than

Data provided and compiled by NWES.

Table 6 - Chemical Test Data of Solidified Pond Sludge

<u>Analyte</u>	<u>Average Result</u>	<u>Range of Results</u>
PCB (mg/kg)	27.5	0.02 to 130
As (mg/L)	1.0	0.8 to 1.2
Ba (mg/L)	4.9	0.1 to 4.4
Cd (mg/L)	1.1	0.005 to 8.2
Cr (mg/L)	409	0.1 to 4000
Hg (mg/L)	0.008	0.008
Pb (mg/L)	44	0.01 to 120

Analyses by Laucks as compiled by NWES and Hart Crowser, Inc.

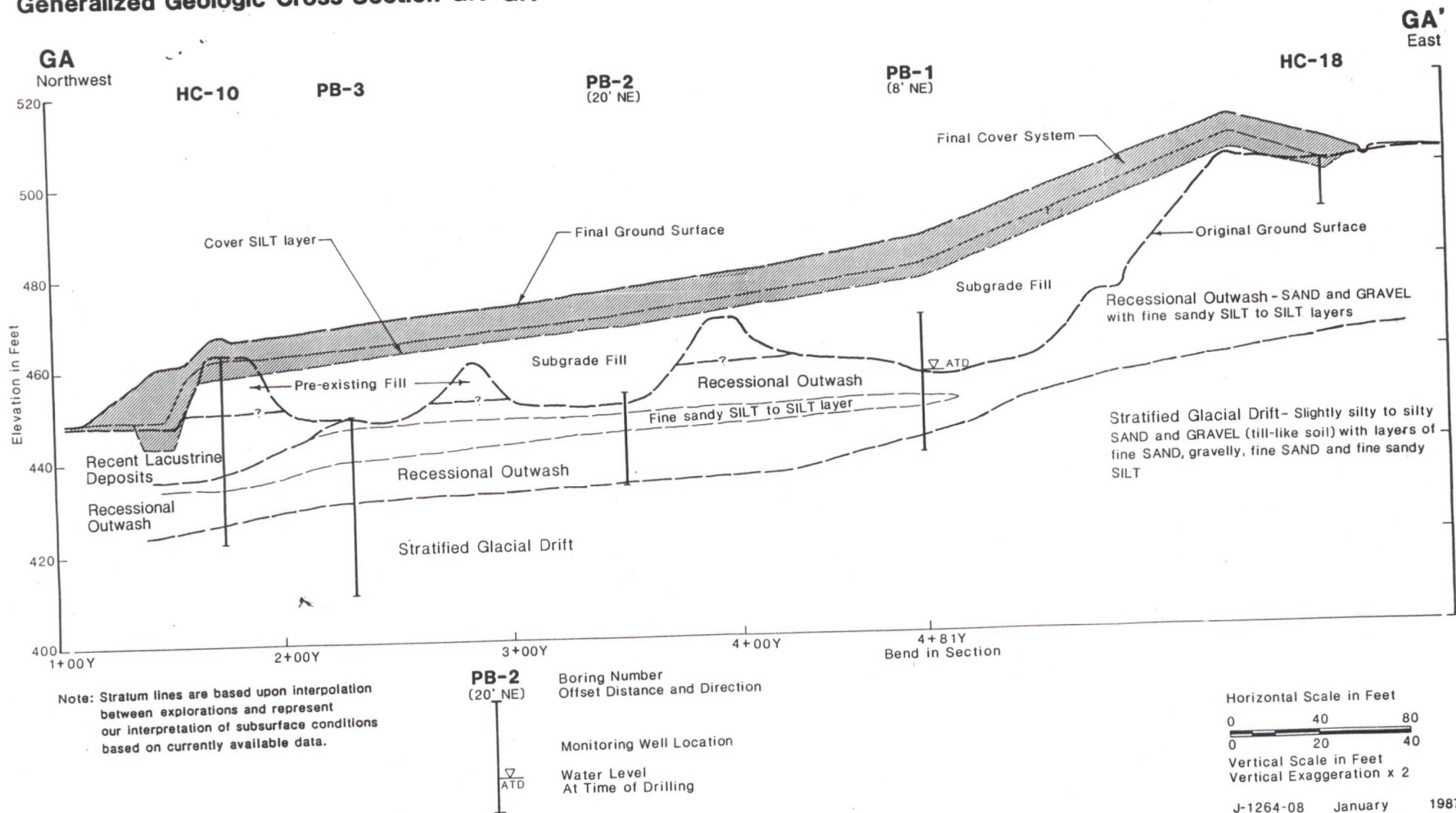
Table 7 Summary of Geotechnical Laboratory Tests on SILT Cover Soils

Material	200 Wash				Moisture Content				Atterberg Limits							Laboratory Moisture-Density Relationship	
	No. of Tests	Percent Passing No. 2 Sieve			No. of Tests	Moisture Content in Percent			No. of Tests	Water Content in Percent						Optimum Moisture Content in Percent	Dry Unit Weight in pcf
		Low	High	Avg.		Low	High	Avg.		Nat. Water Cont.	Liquid Limit Avg.	Limit St. Dev	Plasticity Index Avg.	Index St. Dev	Spec.		
SILT Type I																	
(Field Tests)					42	29	50	35									
(Lab Tests)	49	85	100	7					30	37	58	5	37	4	4 min.		
(Moisture-Density Relationship)	2			99 100												30 29	88 93
SILT Type II																	
(Field Tests)	69	54	71	63	69	11	19	14									
(Lab Tests)	64	46	83	58					28	13	21	3	7	3	4 min.		
(Moisture-Density Relationship)	6			57 57 58 57 65 76						9 13 11 12 15	19 17 19 22 27		4 3 5 8 10	4 min. 4 min. 4 min. 4 min. 4 min.		11 13 11 11 12 16	123 121 124 126 121 115
SILT Type III																	
(Field Tests)					4	23	27	24									
(Lab Tests)	3			95					3	24	41	-	20		4 min.		
(Moisture-Density Relationship)	1			95					1	24	40	-	19		4 min.	20	103

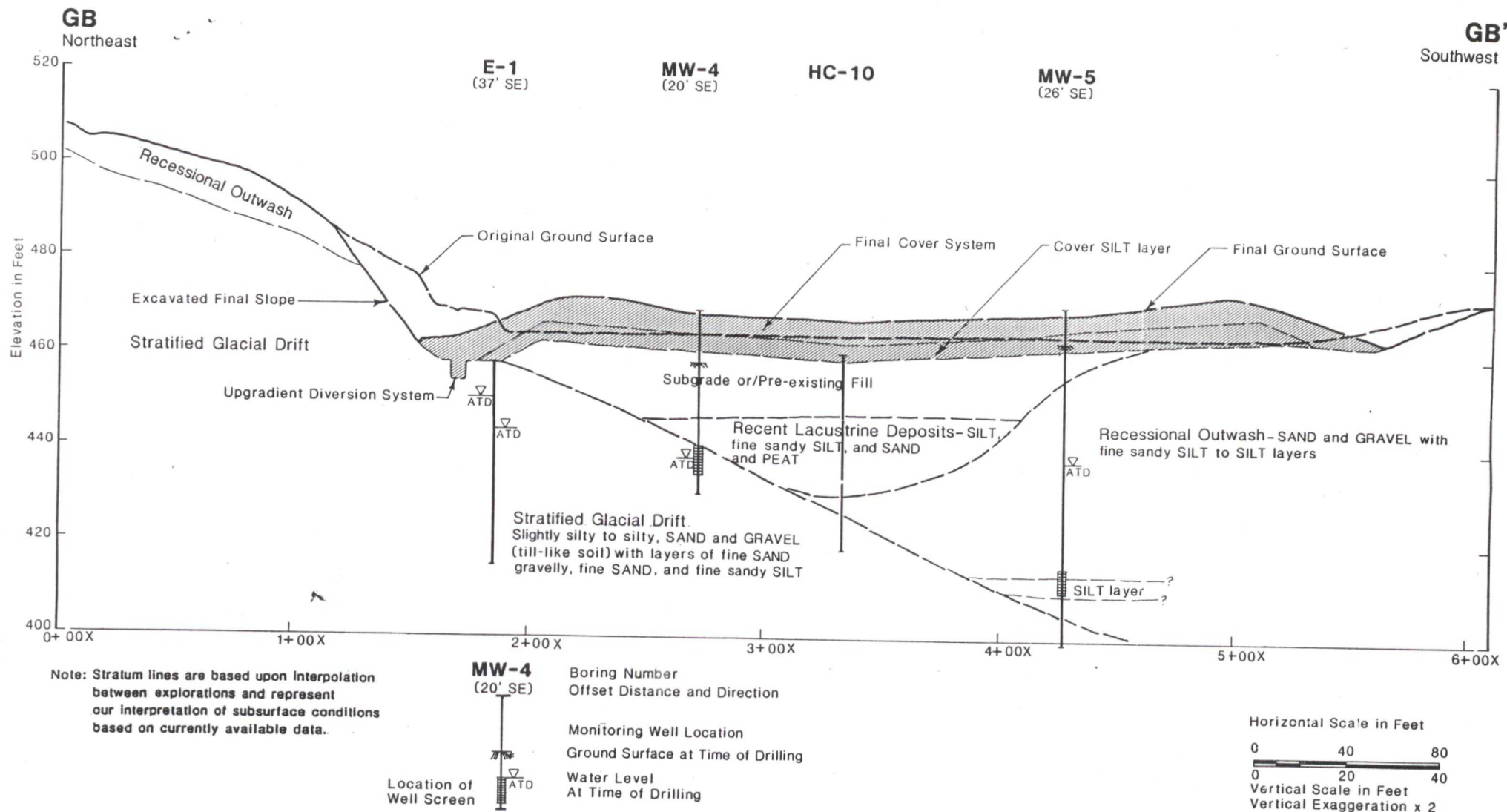
Table 8 - Summary of Geomembrane Seam Repairs

<u>Seam</u>	<u>"Reglues"</u>	<u>Patches</u>	<u>Seam</u>	<u>"Reglues"</u>	<u>Patches</u>
A - AA	--	2	I - J	1	3
A - I	14	10	I - F	12	3
A - II	--	2	J - F	8	8
B - I	3	3	J - H	28	7
B - K	3	7	F - H	4	1
B - BB	--	6	F - E	11	30
BB - K	--	5	E - H	26	2
B - I	5	2	H - G	22	1
B - J	4	12	G - E	1	--
			G - D	1	1
			D - E	11	2

Generalized Geologic Cross Section GA-GA'



Generalized Geologic Cross Section GB-GB'



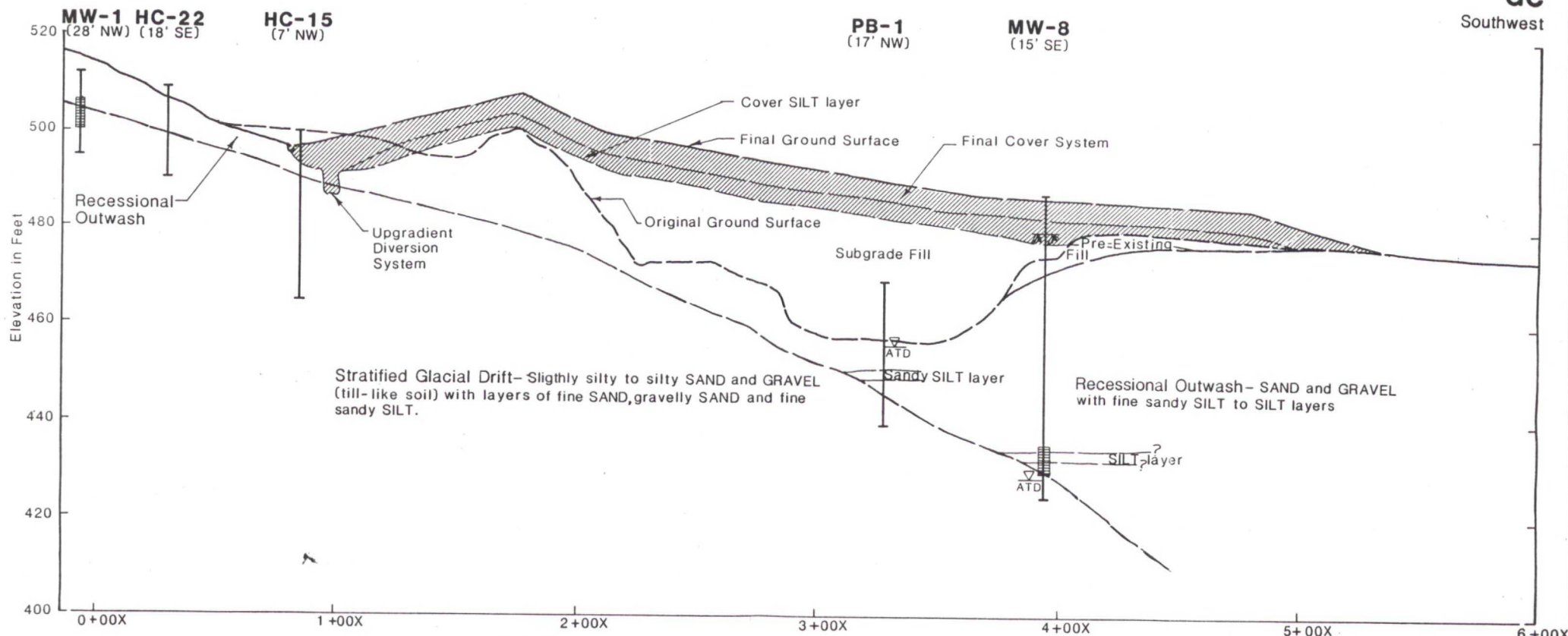
Generalized Geologic Cross Section GC-GC'

GC

Northeast

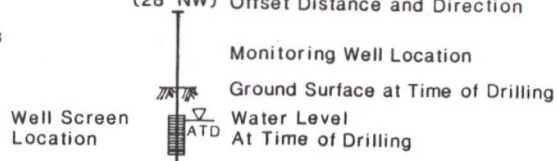
GC'

Southwest



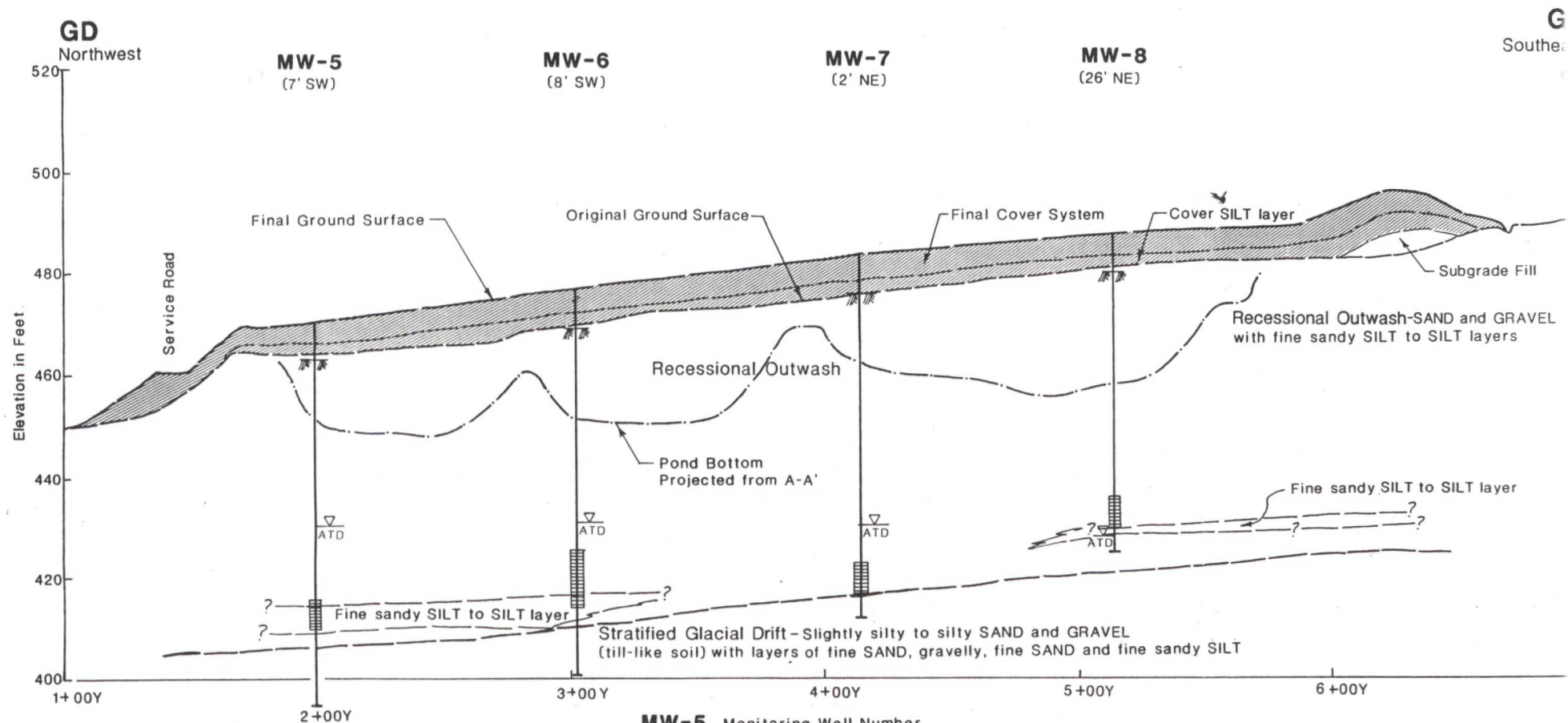
Note: Stratum lines are based upon interpolation between explorations and represent our interpretation of subsurface conditions based on currently available data.

MW-1 Boring Number
(28' NW) Offset Distance and Direction

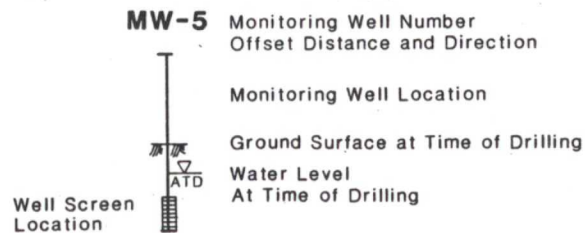


Horizontal Scale in Feet
0 40 80
0 20 40
Vertical Scale in Feet
Vertical Exaggeration x 2

Generalized Geologic Cross Section GD-GD'



Note: Stratum lines are based upon interpolation between explorations and represent our interpretation of subsurface conditions based on currently available data.



Horizontal Scale in Feet
0 40 80
0 20 40
Vertical Scale in Feet
Vertical Exaggeration x 2

J-1264-08 January 19
HART-CROWSER & associates
Figure 4

APPENDIX A
FIELD EXPLORATIONS

The program of subsurface explorations for this project included completion of eight monitoring wells, three pond borings, and two engineering borings. The results of our exploration program are presented on the exploration logs within this Appendix. The exploration logs are a representation of our interpretation of the drilling, and testing information. The depth where the soils or characteristics of the soils changed is noted. The change may be gradual. Soil samples recovered in the explorations were visually classified in the field in general accordance with the method presented on Figure A-1. A legend for the field exploration logs defining symbols and abbreviations utilized is also presented on Figure A-1.

The exploration locations are presented on As-Built Sheet 1. The explorations were originally located in the field by hand taping from existing physical features. The actual locations and ground surface elevations of the explorations, as given in this report, were established during a site survey by Pool Engineering, Inc. The ground surface elevations are presented on the exploration logs.

Borings

A total of 13 monitoring well and exploration borings, designated MW-1 through MW-8, PB-1 through PB-3, and E-1 and E-2, were drilled from July 1, 1986 to August 8, 1986. The borings were completed to depths ranging from 14.5 to 68.8 feet below the ground surface, before the cover system was started. These borings were advanced with a truck-mounted drill rig under subcontract to Hart Crowser, and fitted for using a hollow-stem auger or ODEX drilling systems.

The drilling system consisted of a hydraulically operated continuous-flight 4-inch inside diameter hollow-stem auger. The auger consists of bolted or threaded 5-foot sections of hollow steel casing with welded outside helical auger flights. The auger is twisted into the ground and sampling and well installation is through the center of the auger.

The ODEX drilling system consists of a percussion hammer drill bit (air driven) with two off-set drilling surfaces. The percussion drill advances a hole the same diameter as the casing, which is driven closely following the bit. The drill bits snap together for retrieval up through the casing. The casing is then in-place for return sampling and pull-back type well installation.

The drilling was accomplished under the continuous observation of an engineering geologist from our firm. Detailed field logs were prepared of each boring. Samples were obtained on 2½- to 5-foot-depth intervals using a 2-inch or 3-inch outside diameter, split-spoon samplers. The samplers were driven into the soil a distance of 18 inches using a 140 or 300 pound hammer, free-falling 30 inches. Samples were recovered from the split-barrel sampler, field classified and placed in water-tight jars and taken to our laboratory for further testing.

The boring logs are presented on Figures A-2 through A-14.

Field Mapping

A field mapping program was instigated shortly after the start of the excavation of site soils along the alignment of the upgradient diversion trench. This field program was to identify and locate the contact of the top of "till-like" soil. Horizontal and vertical control for the mapping was referenced off data provided by Pool Engineering, Inc., utilizing hand level and taping methods or as actual survey measurements. Survey control included initial slope cut stakes for earthwork grading; and later included pipe centerline and offset stationary hubs with cut references for pipe invert elevations.

Key to Exploration Logs

Sample Descriptions

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:

Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is estimated based on visual observation and is presented parenthetically on the boring logs.

SAND or GRAVEL	Standard Penetration Resistance in Blows/Foot	SILT or CLAY	Standard Penetration Resistance in Blows/Foot	Approximate Shear Strength in TSF
Density		Consistency		
Very loose	0 - 4	Very soft	0 - 2	<0.125
Loose	4 - 10	Soft	2 - 4	0.125 - 0.25
Medium dense	10 - 30	Medium stiff	4 - 8	0.25 - 0.5
Dense	30 - 50	Stiff	8 - 15	0.5 - 1.0
Very dense	>50	Very stiff	15 - 30	1.0 - 2.0
		Hard	>30	>2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

Minor Constituents

Minor Constituents	Estimated Percentage
Not identified in description	0 - 5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Legends

Sampling

BORING SAMPLES

- ☒ Split Spoon
- ☒ Shelby Tube
- ☒ Cuttings
- ☒ Core Run
- * No Sample Recovery
- P Tube Pushed, Not Driven

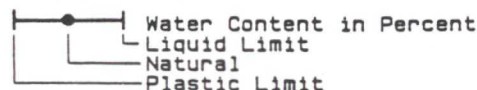
TEST PIT SAMPLES

- ☒ Grab (Jar)
- ☒ Bag
- ☒ Shelby Tube

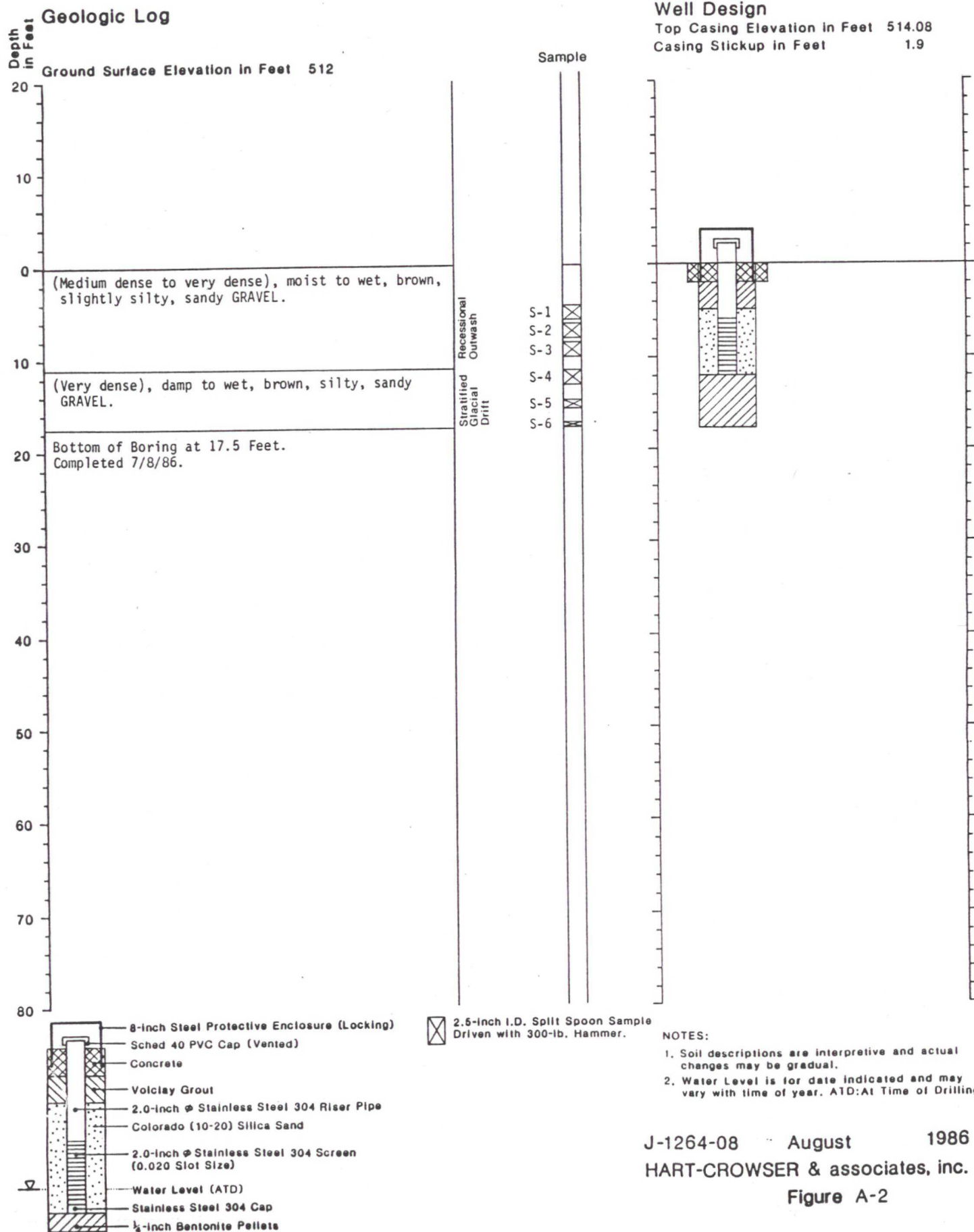
CA Chemical Analysis
(see laboratory reports in Appendix C).

Test Symbols

- GS Grain Size Classification
- CN Consolidation
- TUU Triaxial Unconsolidated Undrained
- TCU Triaxial Consolidated Undrained
- TCD Triaxial Consolidated Drained
- QU Unconfined Compression
- DS Direct Shear
- K Permeability
- PP Pocket Penetrometer
- PP Approximate Compressive Strength in TSF
- TV Torvane
- TV Approximate Shear Strength in TSF
- CBR California Bearing Ratio
- MD Moisture Density Relationship
- AL Atterberg Limits



Boring Log and Construction Data for Well MW-1



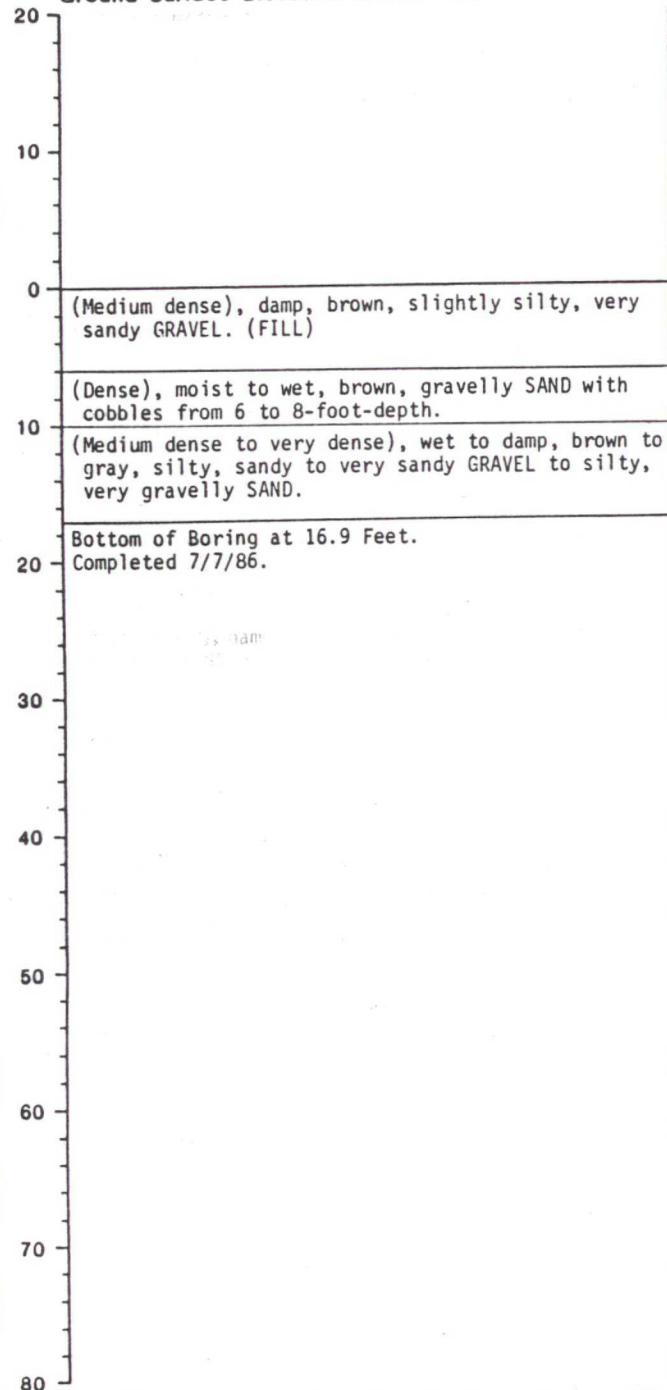
J-1264-08 August 1986
HART-CROWSER & associates, inc.
Figure A-2

Boring Log and Construction Data for Well MW-2

Geologic Log

Depth
in Feet

Ground Surface Elevation in Feet 498

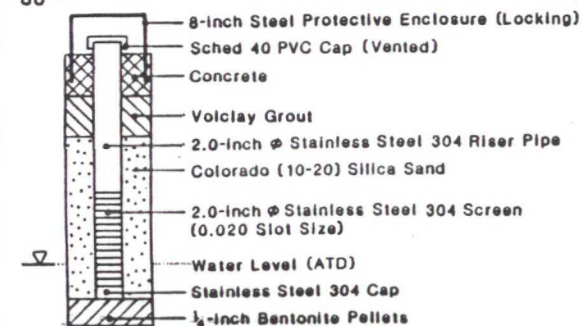
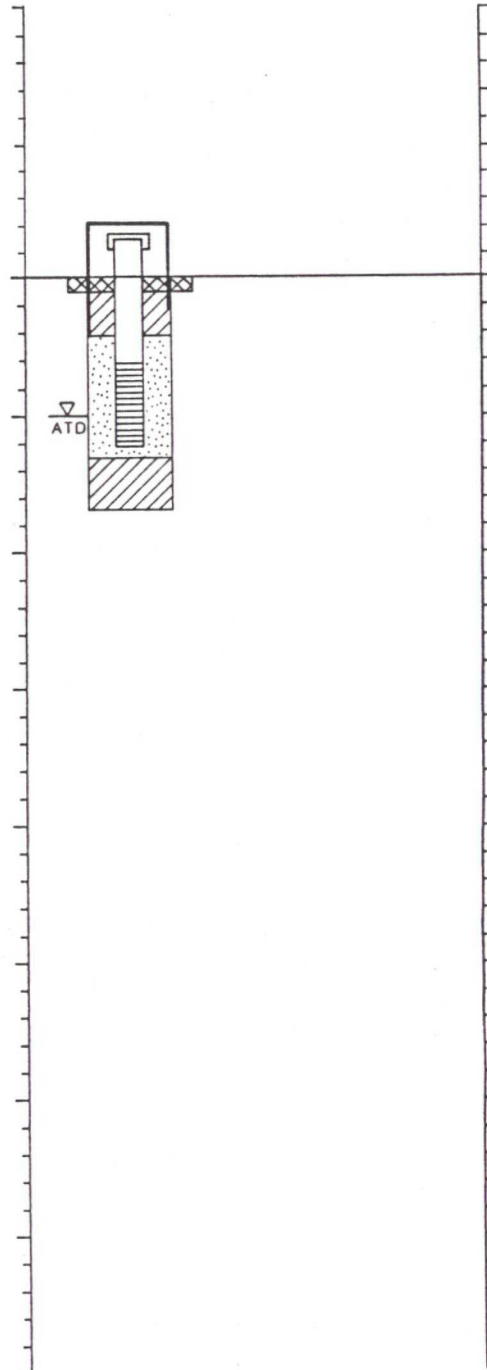


Well Design

Top Casing Elevation in Feet 500.3

Casing Stickup in Feet 2.0

Sample



2.5-Inch I.D. Split Spoon Sample Driven with 300-lb. Hammer.

NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD:At Time of Drilling

J-1264-08 August 1986
HART-CROWSER & associates, inc.
Figure A-3

Boring Log and Construction Data for Well MW-3

Geologic Log

Depth in Feet
Ground Surface Elevation in Feet 496

20
10
0
(Dense to medium dense), moist to wet, brown to gray, slightly silty, very sandy GRAVEL to slightly silty, very gravelly SAND.
10
(Very dense), moist to damp, brown to gray, silty, very gravelly SAND to very sandy GRAVEL.
Bottom of Boring at 14.5 Feet.
Completed 7/1/86.

Recessional
Outwash

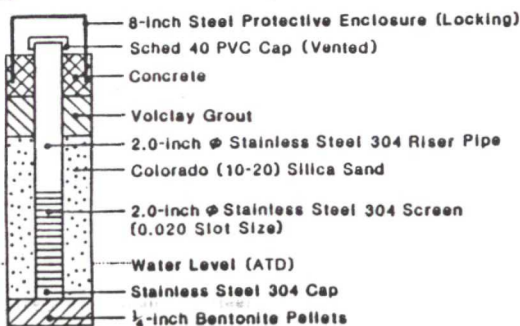
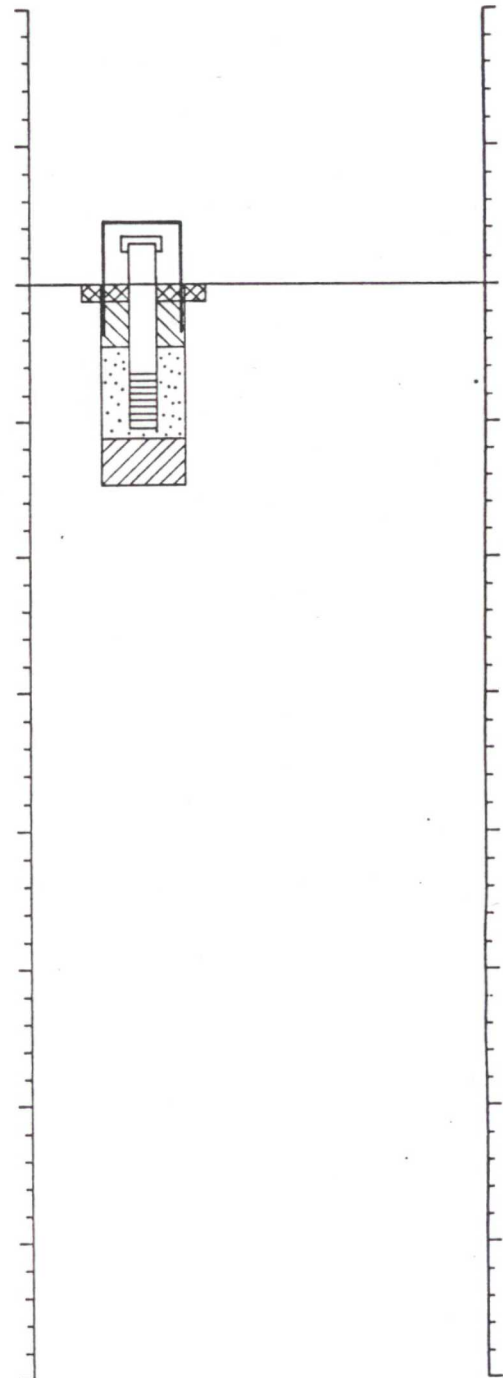
Stratified
Glacial
Drift

Sample

S-1
S-2
S-3
S-4
S-5

Well Design

Top Casing Elevation in Feet 498.43
Casing Stickup in Feet 2.2



2.5-inch I.D. Split Spoon Sample
Driven with 300-lb. Hammer.

NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD: At Time of Drilling

J-1264-08 August 1986

HART-CROWSER & associates, inc.

Figure A-4

Boring Log and Construction Data for Well MW-4

Geologic Log

Ground Surface Elevation in Feet 469

Cover system. See Monitor Well Seal detail, Sheet No. 8 As Built Drawings. Drilling completed prior to cover installation.

Ground Surface Elevation ATD 458 Feet

(Medium dense to loose), damp to moist, gray to brown, silty to slightly silty, gravelly SAND with some brick fragments, wood, and hydrocarbon coatings. (FILL)

(Loose to medium dense), moist, black, silty, fine SAND with hydrocarbon-like odor and coatings.

(Dense to very dense), moist to wet, mottled gray and red brown, slightly silty to silty, gravelly, fine to medium SAND, hydrocarbon-like odor, and black spotty hydrocarbon coatings (Sample S-6).

(Very dense), moist, mottled gray and brown, silty, gravelly, fine to medium SAND.

Bottom of Boring at 28.3 Feet.
Completed 9/8/86.

Recent
Deposits

Stratified Glacial
Drift

Sample

S-1
S-2
S-3
S-4
S-5
S-6
S-7
S-8
S-9
S-10
S-11

Well Design

Top Casing Elevation in Feet 471.74

Casing Stickup in Feet 2.5

ATD

Pea Gravel

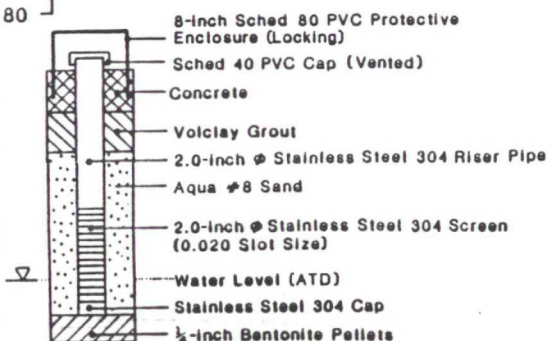
2.5-inch I.D. Split Spoon Sample
Driven with 300-lb. Hammer.

NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD: At Time of Drilling

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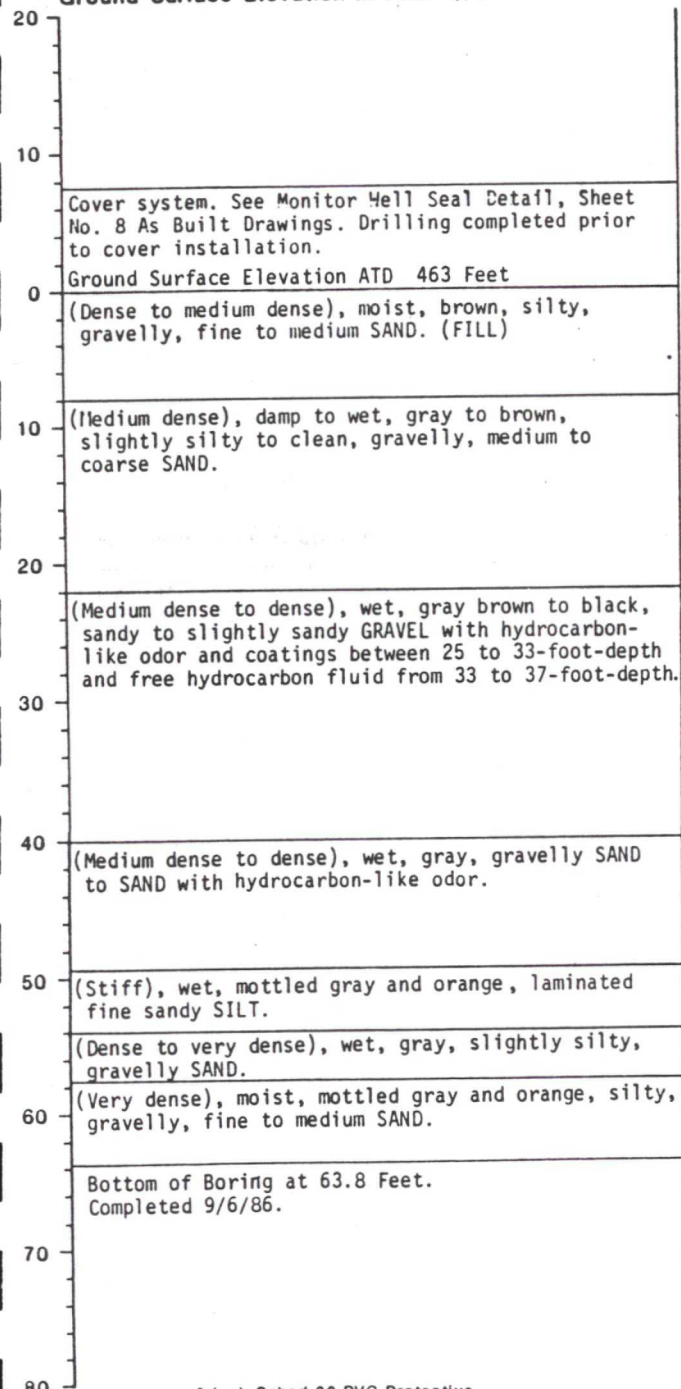
Figure A-5



Boring Log and Construction Data for Well MW-5

Geologic Log

Ground Surface Elevation in Feet 471



Recessional Outwash

Stratified Glacial Drift

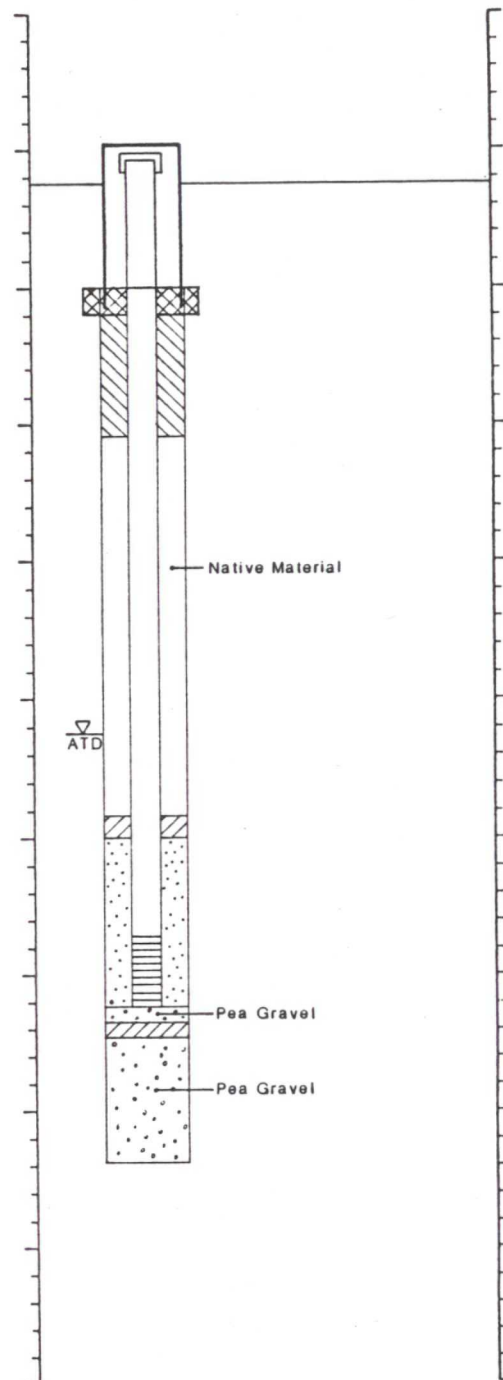
Sample

S-1
S-2
S-3
S-4
S-5
S-6
S-7
S-8
S-9
S-10
S-11
S-12
S-13
S-14
S-15
S-16
S-17
S-18

Well Design

Top Casing Elevation in Feet 473.16

Casing Stickup in Feet 2.6

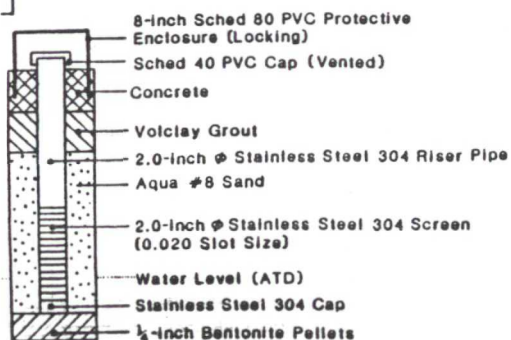


2.5-Inch I.D. Split Spoon Sample Driven with 300-lb. Hammer.

NOTES:

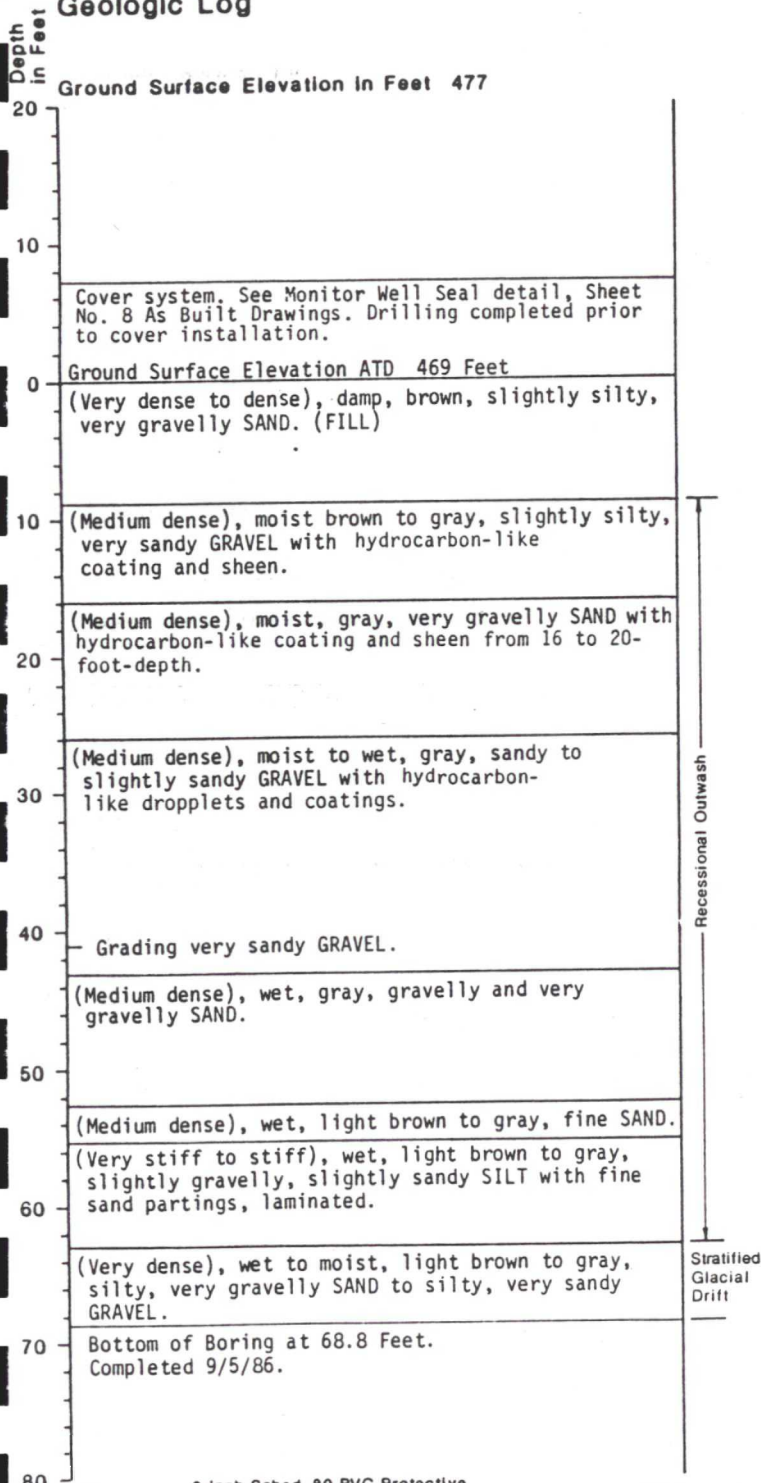
1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD: At Time of Drilling

J-1264-08 August 1986
HART-CROWSER & associates, inc.
Figure A-6



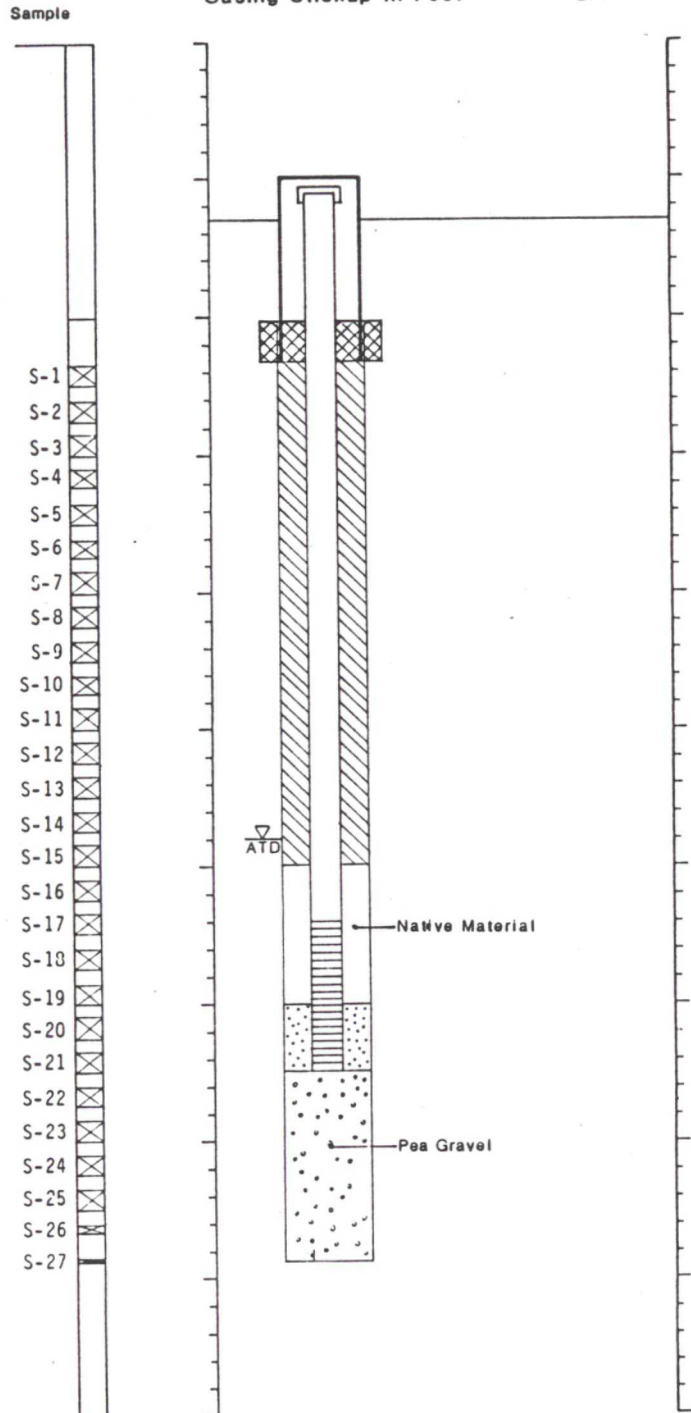
Boring Log and Construction Data for Well MW-6

Geologic Log



Well Design

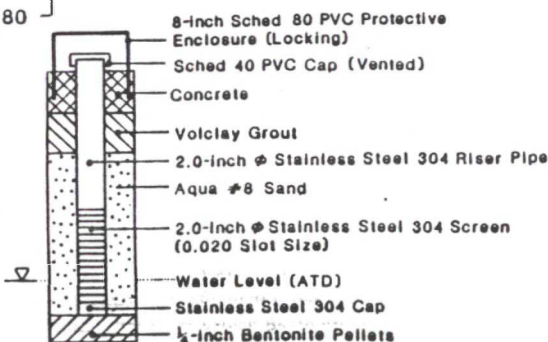
Top Casing Elevation in Feet 479.03
Casing Stickup in Feet 2.4



2.5-inch I.D. Split Spoon Sample
Driven with 300-lb. Hammer.

NOTES:

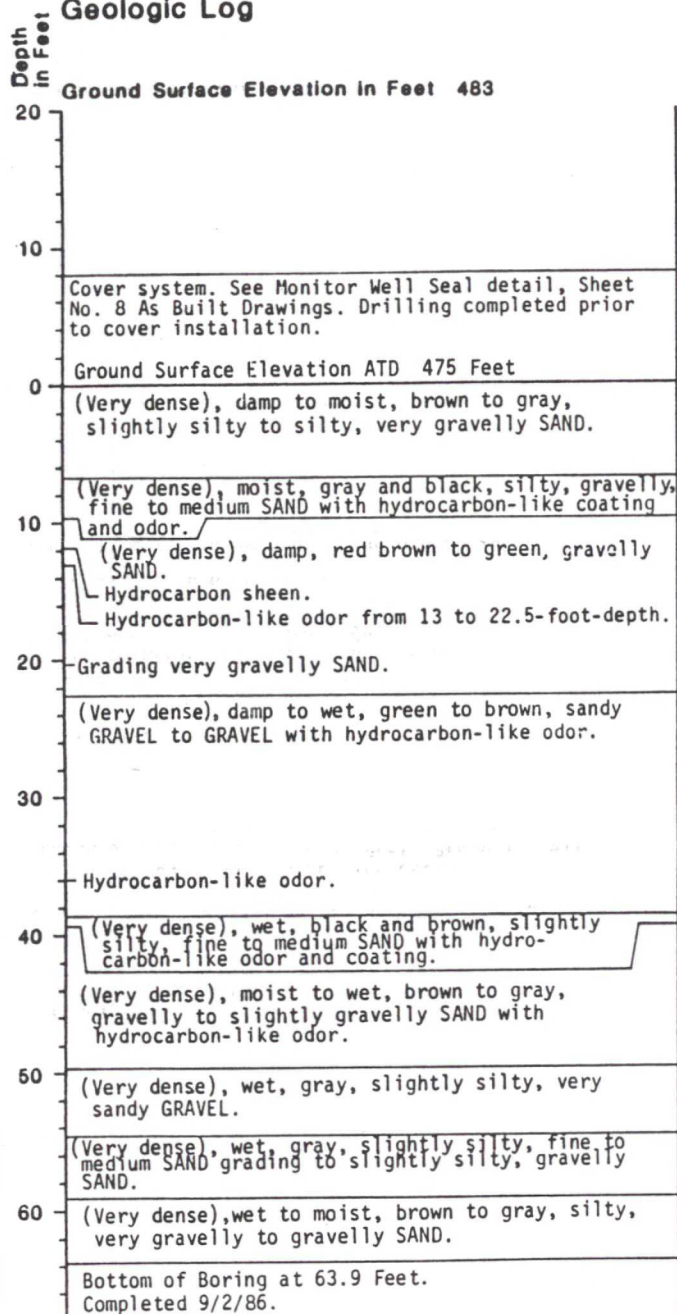
1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD: At Time of Drilling



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HART-CROWSER & associates, inc.
Figure A-7

Boring Log and Construction Data for Well MW-7

Geologic Log



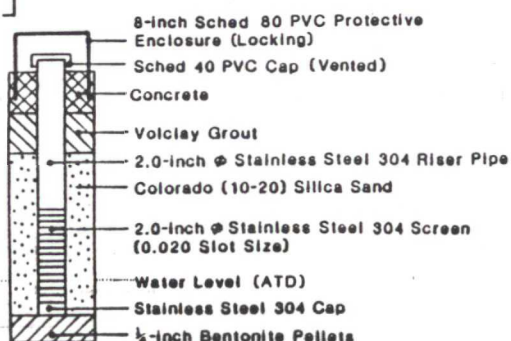
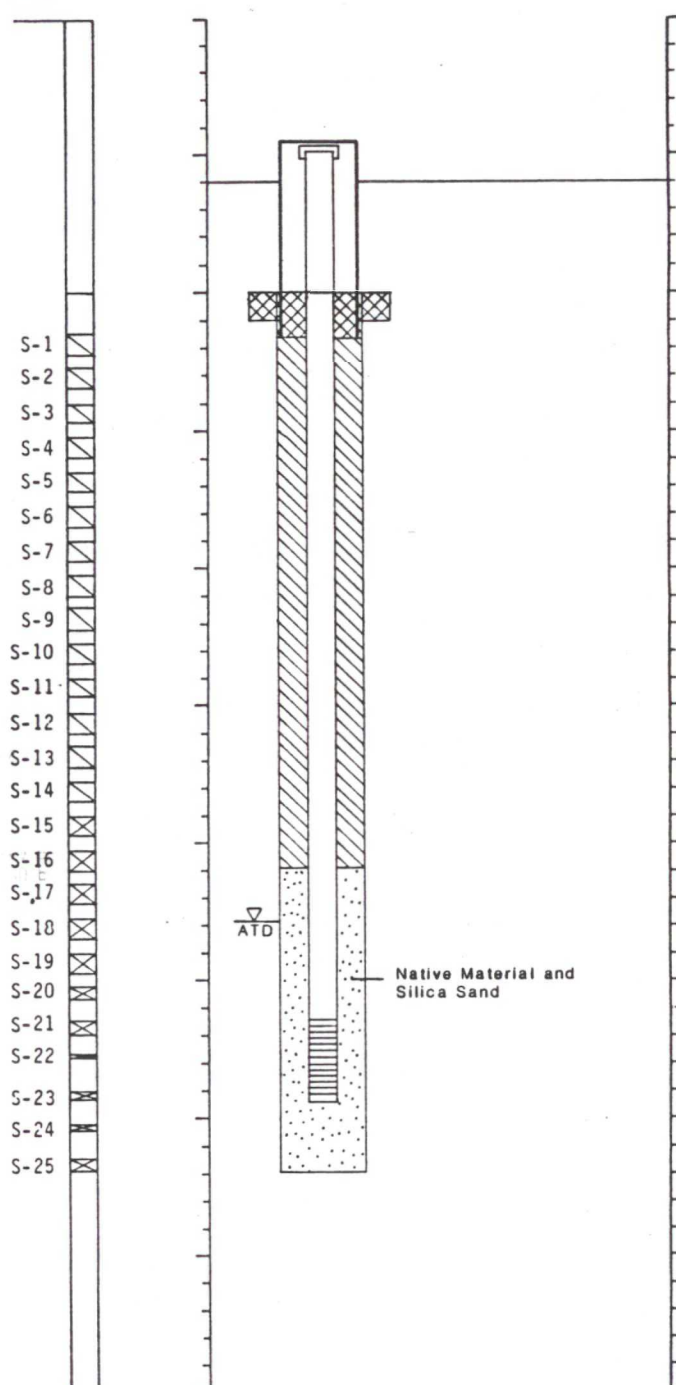
Recessional Outwash

Stratified Glacial Drift

Well Design

Top Casing Elevation in Feet 485.82
Casing Stickup in Feet 2.7

Sample



2.5-inch I.D. Split Spoon Sample Driven with 300-lb. Hammer.

2.5-inch I.D. Split Spoon Sample Driven with 140-lb. Hammer

NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD: At Time of Drilling

J-1264-08 August 1986

HART-CROWSER & associates, inc.

Figure A-8

Boring Log and Construction Data for Well MW-8

Geologic Log

Well Design

Top Casing Elevation in Feet 490.28

Casing Stickup in Feet 3.2

Ground Surface Elevation in Feet 487

Depth
in Feet

20

10

0

10

20

30

40

50

60

70

80

Cover system. See Monitor Well Seal detail, Sheet No. 8 As Built Drawings. Drilling completed prior to cover installation.

Ground Surface Elevation ATD 479 Feet

(Dense to loose), moist, brown, silty, gravelly, fine to medium SAND with organic matter and charcoal. (FILL)

(Very loose to loose), moist, brown to black, sandy GRAVEL with hydrocarbon-like fluid below 12-foot-depth.

(Medium dense to dense), moist, black to gray, slightly silty to clean, gravelly SAND with hydrocarbon-like coatings and sheen to 19 feet.

(Medium dense), moist to damp, brown to gray, medium to coarse sandy GRAVEL.

(Medium dense), damp, gray and black, gravelly SAND with hydrocarbon coating.

(Medium dense), moist, gray and black, silty, gravelly, fine to medium SAND with hydrocarbon fluid.

(Very dense to dense), moist, black to gray, gravelly SAND with hydrocarbon coating to 44 feet.

(Stiff), moist, gray SILT.

(Very dense), moist, gray, very gravelly, silty SAND with hydrocarbon fluid.

(Very dense), wet, gray, silty, gravelly to very gravelly SAND with hydrocarbon coating to 53 feet.

Bottom of Boring at 55.0 Feet.
Completed 8/8/86.

Recessional Outwash

Stratified
Glacial
Drift

Sample

S-1
S-2
S-3
S-4
S-5
S-6
S-7
S-8
S-9
S-10
S-11
S-12
S-13
S-14
S-15
S-16
S-17
S-18
S-19
S-20
S-21

ATD

8-inch Sched 80 PVC Protective
Enclosure (Locking)

Sched 40 PVC Cap (Vented)

Concrete

Volclay Grout

2.0-inch ϕ Stainless Steel 304 Riser Pipe

Colorado (10-20) Silica Sand

2.0-inch ϕ Stainless Steel 304 Screen
(0.020 Slot Size)

Water Level (ATD)

Stainless Steel 304 Cap

$\frac{1}{2}$ -inch Bentonite Pellets

2.5-Inch I.D. Split Spoon Sample
Driven with 300-lb. Hammer.

NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD: At Time of Drilling

J-1264-08 August 1986
HART-CROWSER & associates, inc.
Figure A-9

Boring Log PB-1

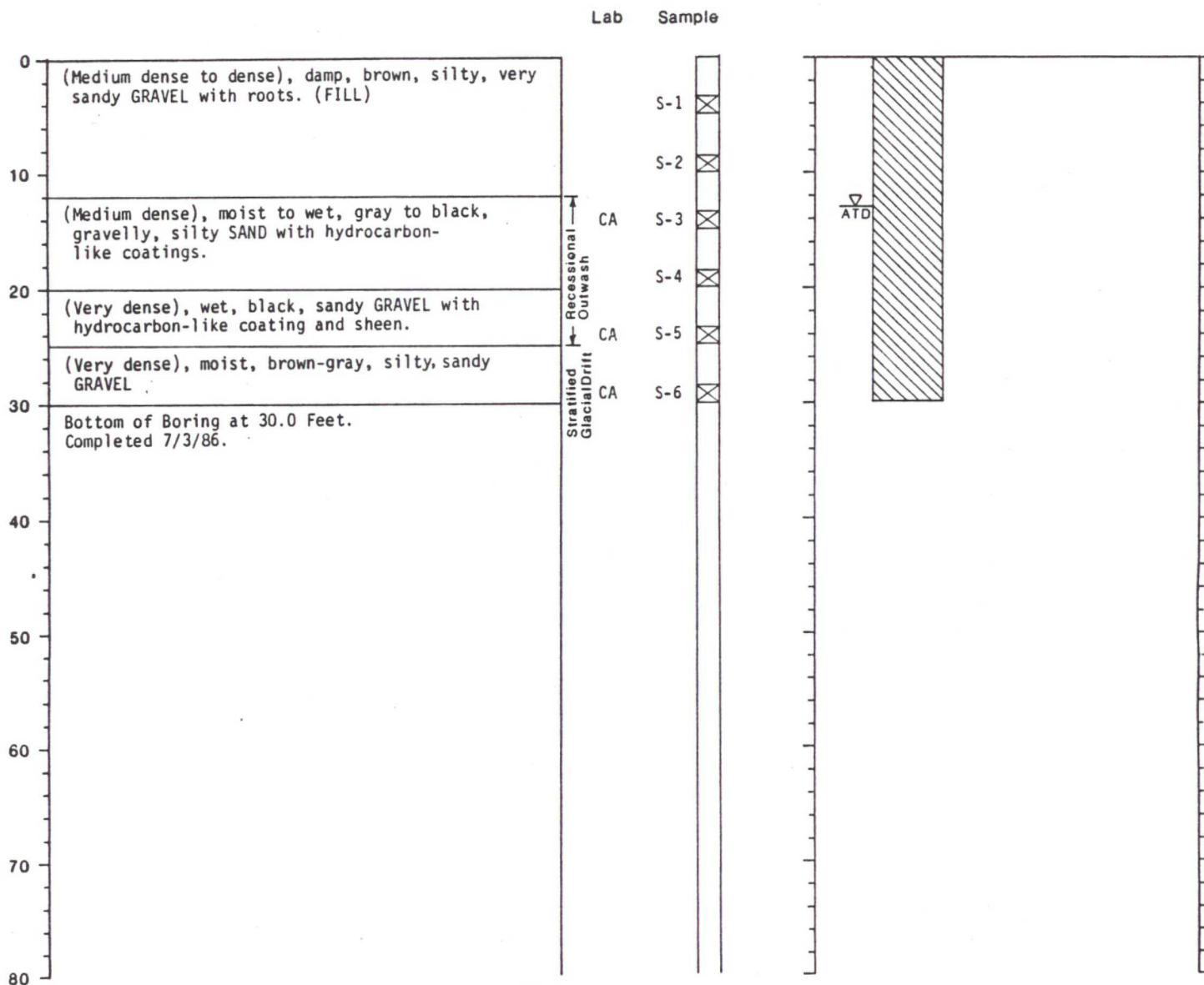
Geologic Log

Depth
in Feet

Ground Surface Elevation in Feet 469

Well Design

Top Casing Elevation in Feet
Casing Stickup in Feet



2.5-inch I.D. Split Spoon Sample
Driven with 300-lb. Hammer.

NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD: At Time of Drilling

J-1264-08 August 1986
HART-CROWSER & associates, inc.
Figure A-10

Boring Log PB-2

Geologic Log

Well Design

Top Casing Elevation in Feet
Casing Stickup in Feet

Depth
in Feet

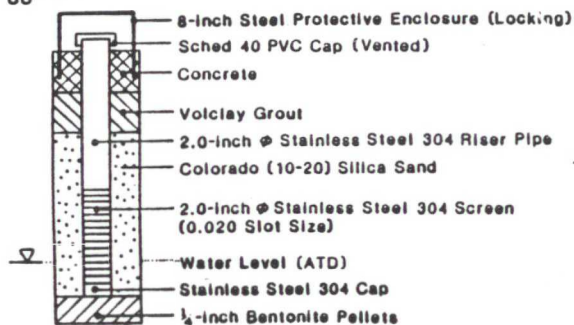
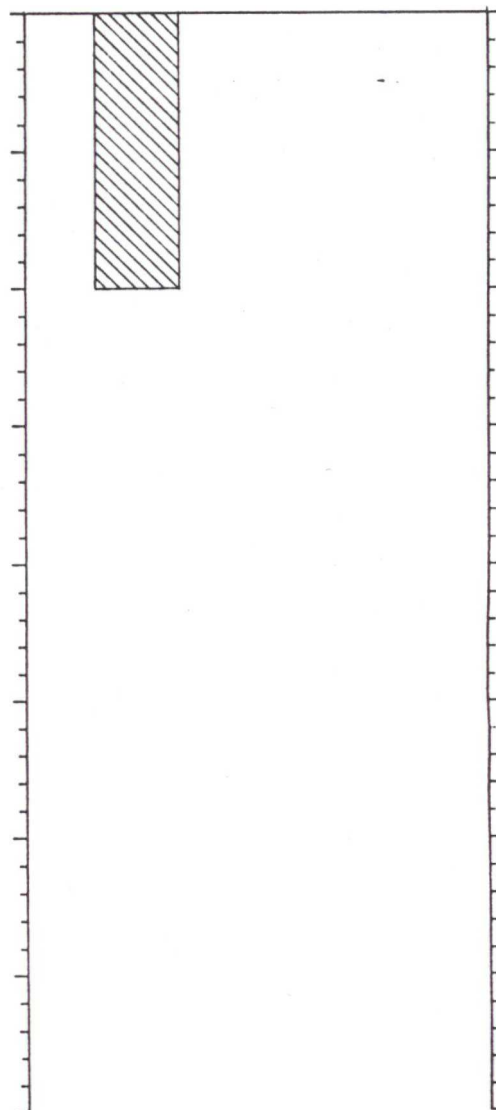
Ground Surface Elevation in Feet 453

Lab Sample

0	SAND and GRAVEL. (FILL)
	(Medium stiff), wet to moist, brown, slightly sandy SILT.
10	(Medium dense), moist, gray SAND.
	(Dense), moist, gray, silty, gravelly SAND.
20	(Very dense), damp, brown gray, silty, gravelly SAND.
	Bottom of Boring at 19.8 Feet. Completed 7/2/86.
30	
40	
50	
60	
70	
80	

Recessional
Outwash
Stratified
Glacial
Drift

CA S-1
S-2
CA S-3
CA S-4



2.5-Inch I.D. Split Spoon Sample
Driven with 300-lb. Hammer.

NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD: At Time of Drilling

J-1264-08 August 1986
HART-CROWSER & associates, inc.
Figure A-11

Boring Log PB-3

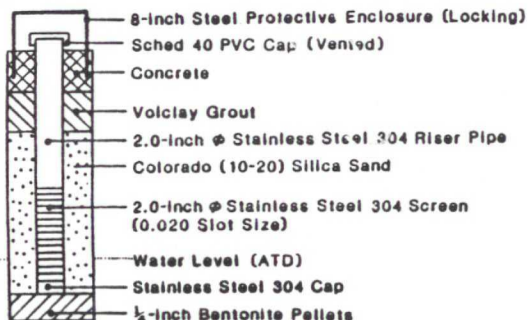
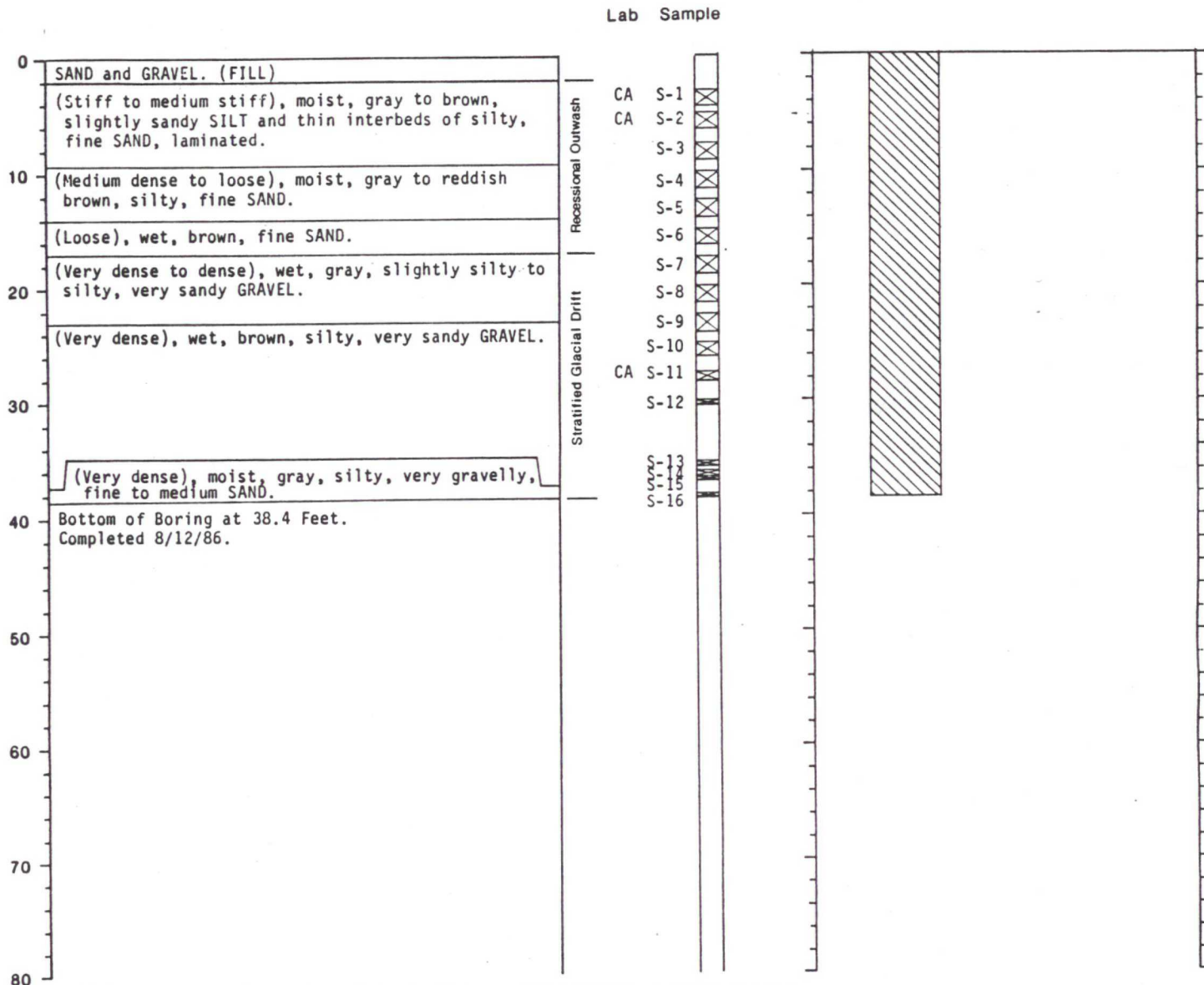
Geologic Log

Depth
in Feet

Ground Surface Elevation in Feet 449

Well Design

Top Casing Elevation in Feet
Casing Stickup in Feet



2.5-inch I.D. Split Spoon Sample
Driven with 300-lb. Hammer.

NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD: At Time of Drilling

J-1264-08 August 1986
HART-CROWSER & associates, inc.
Figure A-12

Boring Log E-1

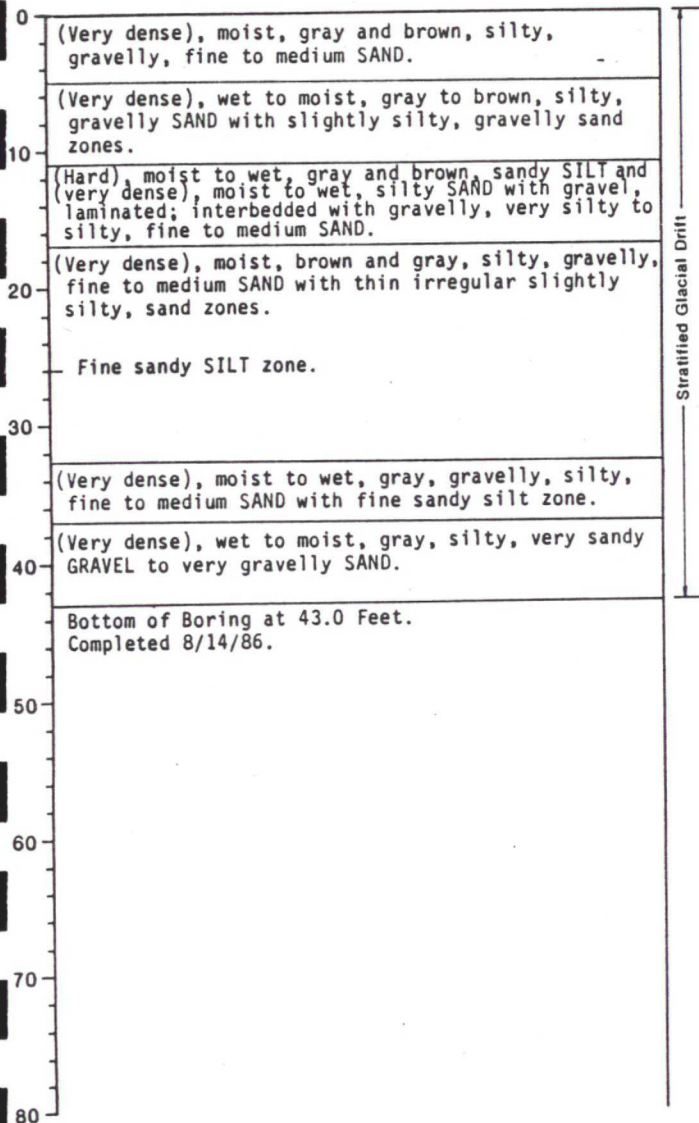
Geologic Log

Ground Surface Elevation in Feet 458

Well Design

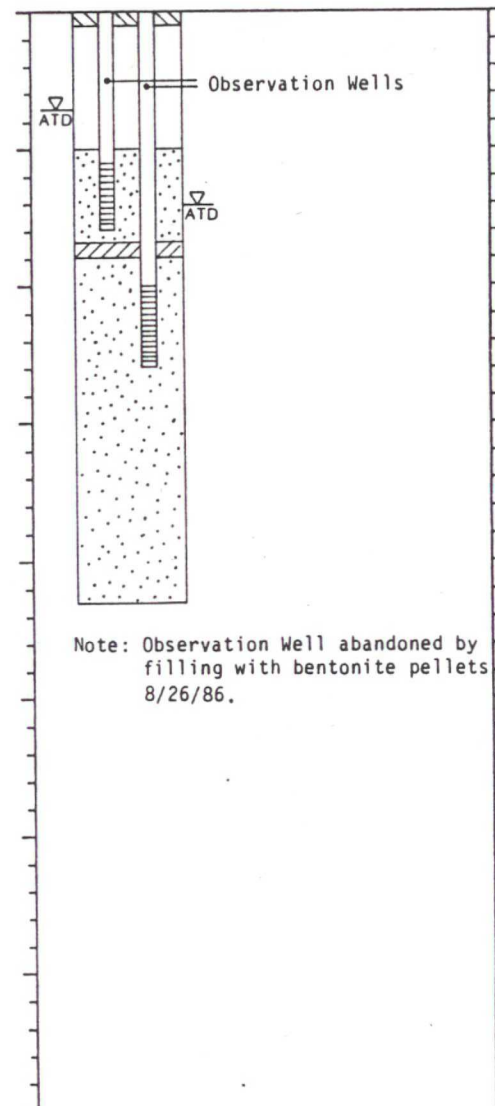
Top Casing Elevation in Feet 458

Casing Stickup in Feet 0.0



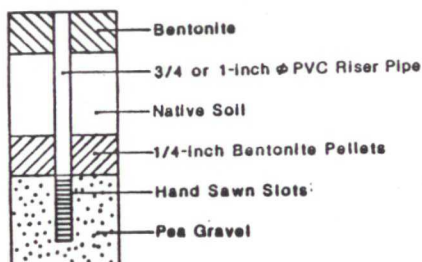
Sample

S-1
S-2
S-3
S-4
S-5
S-6
S-7
S-8
S-9
S-10
S-11
S-12
S-13
S-14
S-15
S-16
S-17
S-18
S-19
S-20
S-21
S-22
S-23
S-24
S-25
S-26
S-27
S-28
S-29
S-30



NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD: At Time of Drilling



2.5-inch I.D. Split Spoon Sample
Driven with 300-lb. Hammer

J-1264-08 December 1986
HART-CROWSER & associates, inc.
Figure A-13

Boring Log E-2

Geologic Log

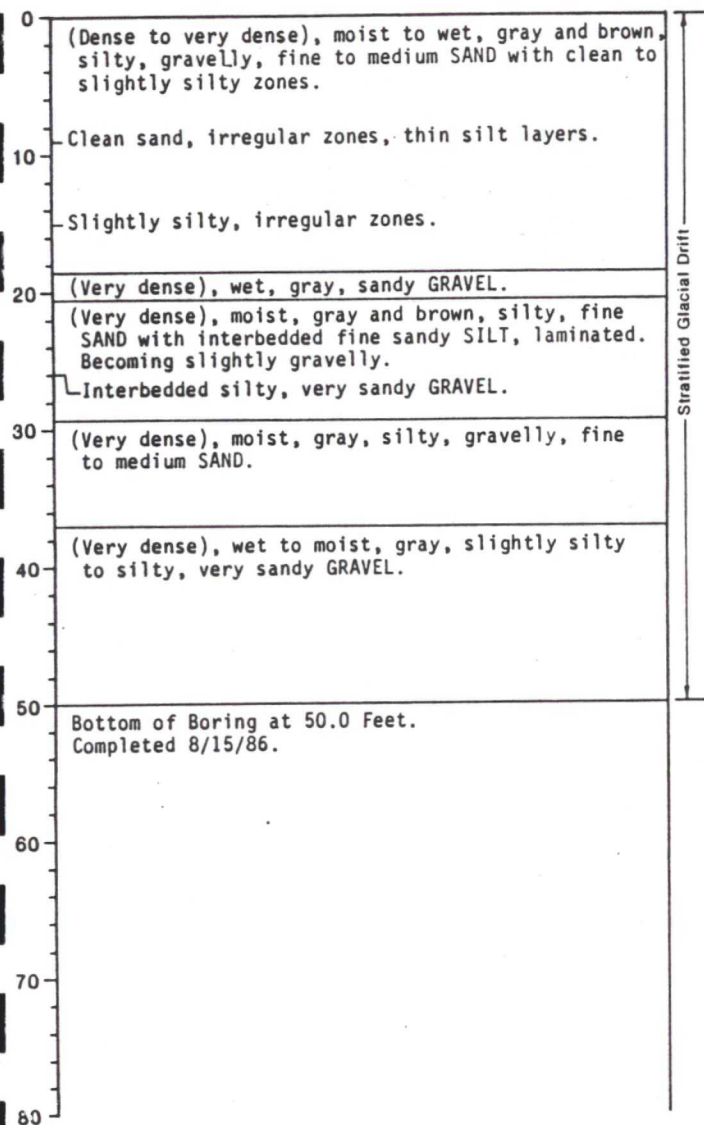
Ground Surface Elevation in Feet 460

Well Design

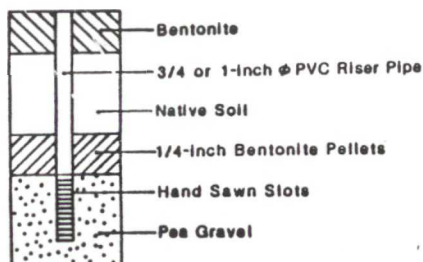
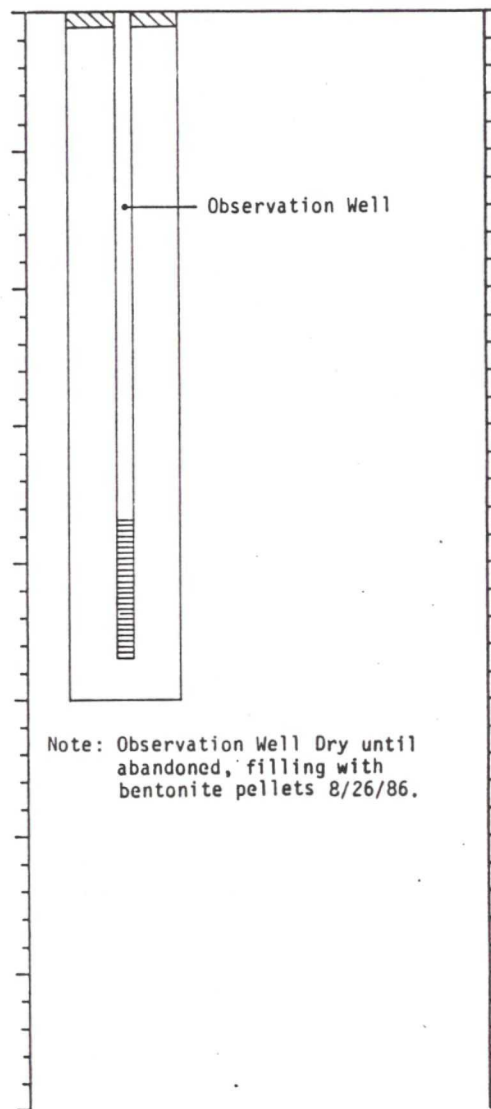
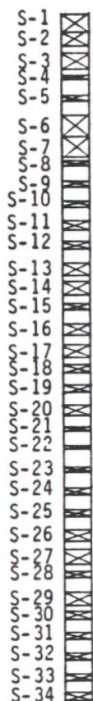
Top Casing Elevation in Feet 460

Casing Stickup in Feet 0.0

Depth
in Feet



Sample



2.5-Inch I.D. Split Spoon Sample
Driven with 300-lb. Hammer

NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD:At Time of Drilling

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Figure A-14

J-1264-08

APPENDIX B
CONSTRUCTION QUALITY CONTROL/
QUALITY ASSURANCE TESTING PROGRAM

A laboratory testing program was performed for this study to evaluate the basic index and geotechnical engineering properties of various project materials. Laboratory tests were performed on various project materials: silt, sand, sand and gravel, pea gravel, bedding sand, pond fill, and other site soils. The laboratory tests performed and the procedures followed are outlined below. The tests were performed at the Hart Crowser laboratory and a field laboratory at the project site.

Soil Classification

Soil samples recovered in the explorations and other soils were visually classified in the field and then taken to our laboratory where the classifications were verified in a relatively controlled environment. Visual-manual field and laboratory observations include density/consistency, moisture condition, grain size and plasticity estimates.

The classifications of selected exploration samples and project materials were checked by performing laboratory tests such as Atterberg limits determinations and grain size analyses. Classifications were made in general accordance with the Unified Soil Classification (USC) System, ASTM D 2487, as presented on Figure B-1.

Water Content Determinations

Water contents were determined for most samples in general accordance with ASTM D 2216. The results of these tests are plotted at the respective sample depth on the exploration logs for exploration samples. Various other material water content are given with other test results.

Atterberg Limits (AL)

Atterberg limits determinations were accomplished for selected fine-grained soil samples, primarily the silt cover soil. The liquid limit and plastic limit were determined in general accordance with ASTM D 423 and ASTM D 424, respectively. The results of the Atterberg limits analyses and the plasticity characteristics are summarized on the Plasticity Chart, Figures B-2, B-3, and B-4, which relates the plasticity index (liquid limit minus the plastic limit) to the liquid limit. The results of the Atterberg limits tests are summarized in Table 7 given earlier in this report, as well as where applicable on figures presenting various other test results.

Grain Size Analysis (GS)

Grain size analyses were performed in general accordance with ASTM D 422. The wet sieve analysis method was used for most samples and determines the size distribution greater than the U.S. No. 200 mesh sieve. The results of the tests are presented as curves on Figures B-5 through B-10 plotting percent finer by weight versus grain size.

200-Wash

One-hundred eighty-five samples of silt cover soils were subjected to a modified grain size classification known as a 200-wash. The samples were "washed" through the No. 200 mesh sieve to determine the relative percentages of coarse and fine-grained material in the samples. The tests were performed in general accordance with ASTM D 1140. The results are summarized in Table 7 given earlier in this report.

Hydraulic Conductivity

Hydraulic conductivity tests were conducted on laboratory compacted or Shelby tube samples of silt cover soils. The purpose of this test is to measure the saturated hydraulic conductivity, a property affecting the rate at which water flows through the soil sample. The tests were performed in

a triaxial cell using "flexible wall" permeameter techniques. Advantages of this technique are the application of confining stress thereby limiting side-wall leakage.

After compaction or trimming, the samples were placed in the triaxial cell, surrounded and sealed by rubber membranes. The samples were then consolidated at confining stresses of about five pounds per square inch.

The hydraulic conductivity test was initiated after consolidation using tap water and falling head techniques. Hydraulic gradients of 10 to 56 were utilized. Flow occurred from the bottom of the sample to the top. The tests were continued until steady state flow occurred. The results of the hydraulic conductivity tests are given in Table B-1.

Moisture-Density Relationship (MD)

Moisture-density tests were performed for silt cover soils and a sand and gravel in general accordance with ASTM D 698 (Standard Proctor Test). The test results plotted in terms of dry density versus water content were used to determine a maximum dry density and optimum moisture content. The data are presented on Figures B-11, B-12, B-13, B-15, and B-16. A correlative plot of maximum dry density versus percent fines (material passing the U.S. No. 200 sieve) for Type II silt soils was prepared and is given on Figure B-14.

In-Place Field Density

In-place field density tests were performed in general accordance with ASTM D 3167 Rubber Balloon method and ASTM D 2937 Drive Cylinder method. The test results were determined in terms of dry density and expressed as a percent of compaction of a maximum dry density (standard Proctor tests). In-place moisture contents were also determined. Results of the in-place density testing are discussed in Section 3.4.4 of this report.

Table B-1 Summary of Hydraulic Conductivity Tests

Material	Atterberg Limits		Percent Fines	Compaction Data			Hydraulic Conductivity Test Data		
	Water Content LL	in Percent PI		Initial Dry Density in PCF	Percent of Maximum Density	Compaction Water Content in Percent	Percent Saturation (Final)	Hydraulic Gradient	Coefficient of Saturated Hydraulic Conductivity in cm/sec
SILT Type I	45 - 58	25 - 32	99 - 100	86	93	31	98	17	2×10^{-6}
	54 - 63	31 - 44	85 - 100	88	95	35	100	53	2×10^{-8}
SILT Type II	27	10	76	114	99	16	99	56	3×10^{-8}
	27	10	76	108	94	16	95	13	2×10^{-6}
	27	10	76	109	95	13	100	56	3×10^{-6}
	19	5	57	125	99	14	100	13	3×10^{-8}
	25	7	74	109	94	15	100	10	3×10^{-7}
	17	3	57	120	95	13	85	17	1×10^{-7}

Notes: LL = Liquid Limit
PI = Plasticity Index

Unified Soil Classification (USC) System

Soil Grain Size

Size of Opening in Inches	Number of Mesh per Inch (US Standard)					Grain Size in Millimetres									
12 6 4 2 1-1/2 1 3/4 5/8 1/2 1/4 3/8 4	10	20	40	60	100	200	.06	.04	.03	.02	.01	.008	.006	.004	.003
300 200 100 80 60 40 30 20 10 8 6 4 3 2 1 .8 .6 .4 .3 .2 .1 .08 .06 .04 .03 .02 .01 .008 .006 .004 .003 .002 .001															

Grain Size in Millimetres

COBBLES	GRAVEL	SAND	SILT and CLAY
Coarse-Grained Soils			Fine-Grained Soils

Coarse-Grained Soils

G W	G P	G M	G C	S W	S P	S M	S C
Clean GRAVEL <5% fines		GRAVEL with >12% fines		Clean SAND <5% fines		SAND with >12% fines	
GRAVEL >50% coarse fraction larger than No. 4				SAND >50% coarse fraction smaller than No. 4			
Coarse-Grained Soils >50% larger than No. 200 sieve							

G W and S W $\left(\frac{D_{60}}{D_{10}}\right) > 4$ for G W & $1 \leq \left(\frac{(D_{30})^2}{D_{10} \times D_{60}}\right) \leq 3$ G P and S P Clean GRAVEL or SAND not meeting requirements for G W and S W

G M and S M Atterberg limits below A Line with PI < 4

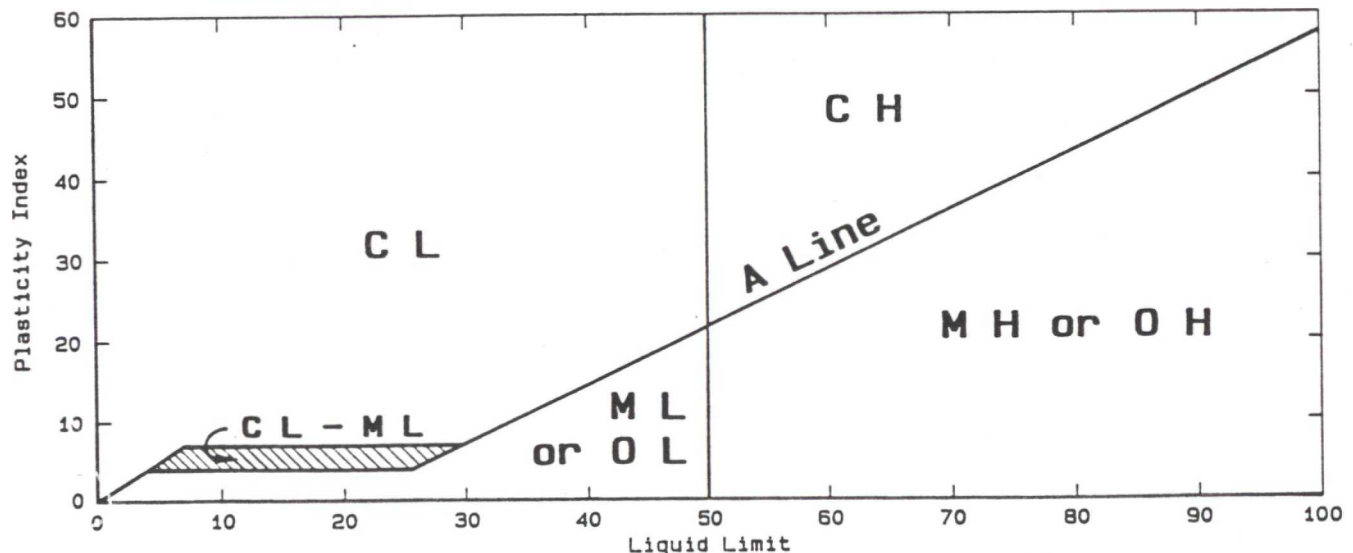
G C and S C Atterberg limits above A Line with PI > 7

* Coarse-grained soils with percentage of fines between 5 and 12 are considered borderline cases requiring use of dual symbols.

D₁₀, D₃₀, and D₆₀ are the particle diameter of which 10, 30, and 60 percent, respectively, of the soil weight are finer.

Fine-Grained Soils

M L	C L	O L	M H	C H	O H	Pt
SILT	CLAY	Organic	SILT	CLAY	Organic	Highly Organic Soils
Soils with Liquid Limit <50%			Soils with Liquid Limit >50%			
Fine-Grained Soils >50% smaller than No. 200 sieve						



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January

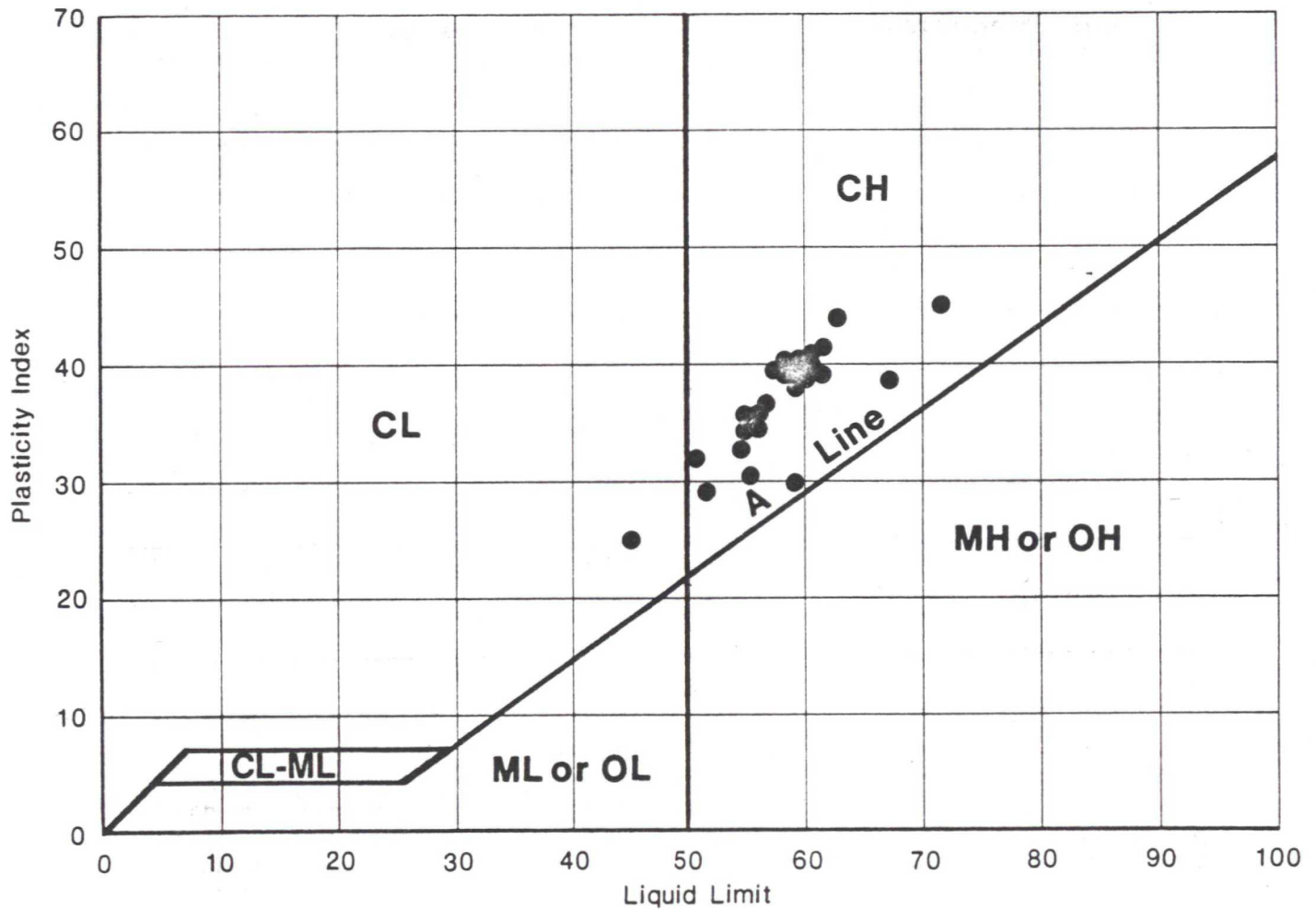
1987

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Figure B-1

Plasticity Chart

Type I SILT



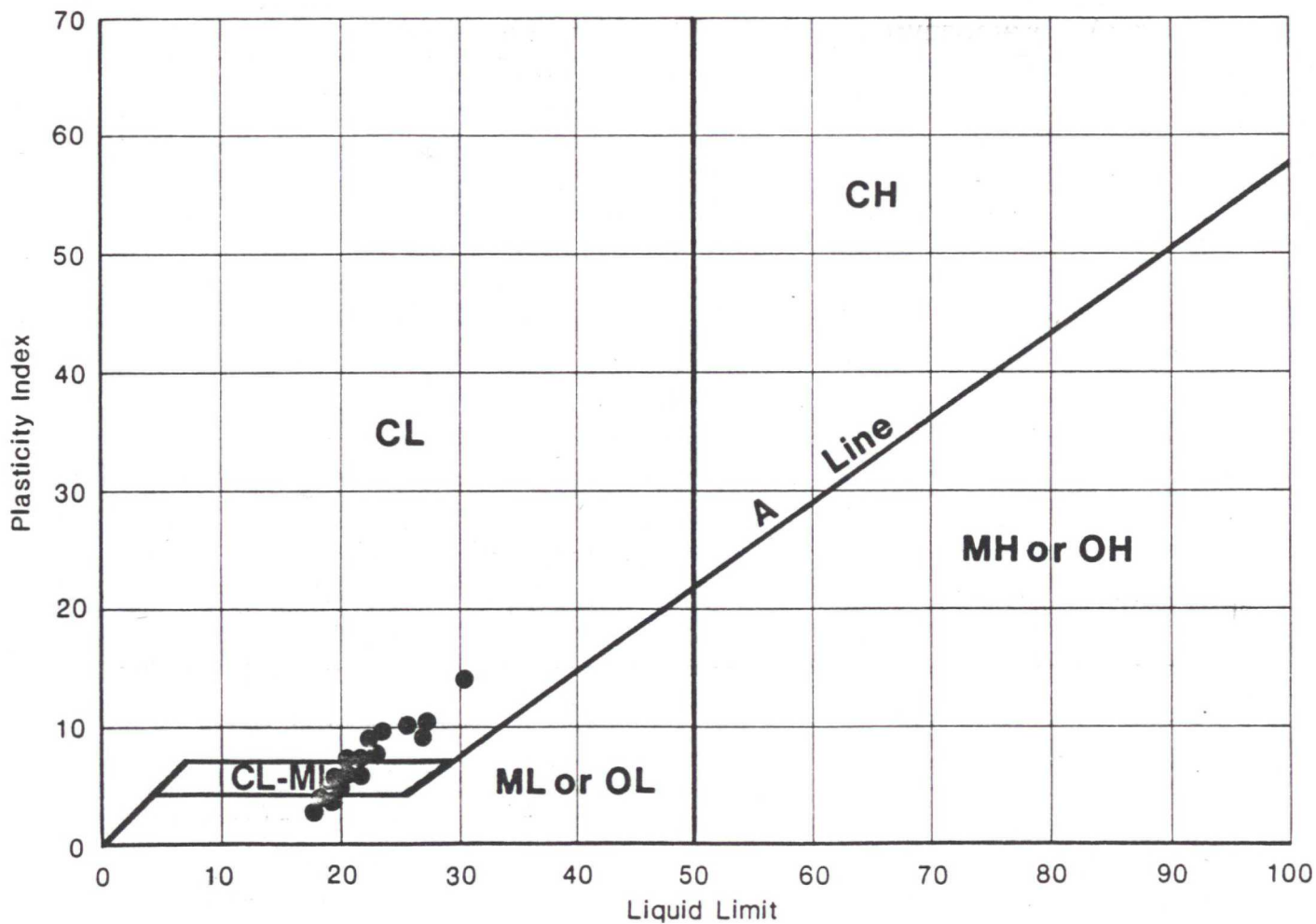
SYMBOL	BORING NUMBER	SAMPLE NUMBER	DEPTH IN FEET	WATER CONTENT IN PERCENT			CLASSIFICATION	USC
				NAT.	L.L.	P.L.		
Plot of 30 Laboratory Tests								

L.L. LIQUID LIMIT
 P.L. PLASTIC LIMIT
 P.I. PLASTICITY INDEX
 USC UNIFIED SOIL CLASSIFICATION

J-1264-05 January 1987
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 Figure B-2

Plasticity Chart

Type II SILT



SYMBOL	BORING NUMBER	SAMPLE NUMBER	DEPTH IN FEET	WATER CONTENT IN PERCENT			CLASSIFICATION	USC
				NAT.	L.L.	P.L.		

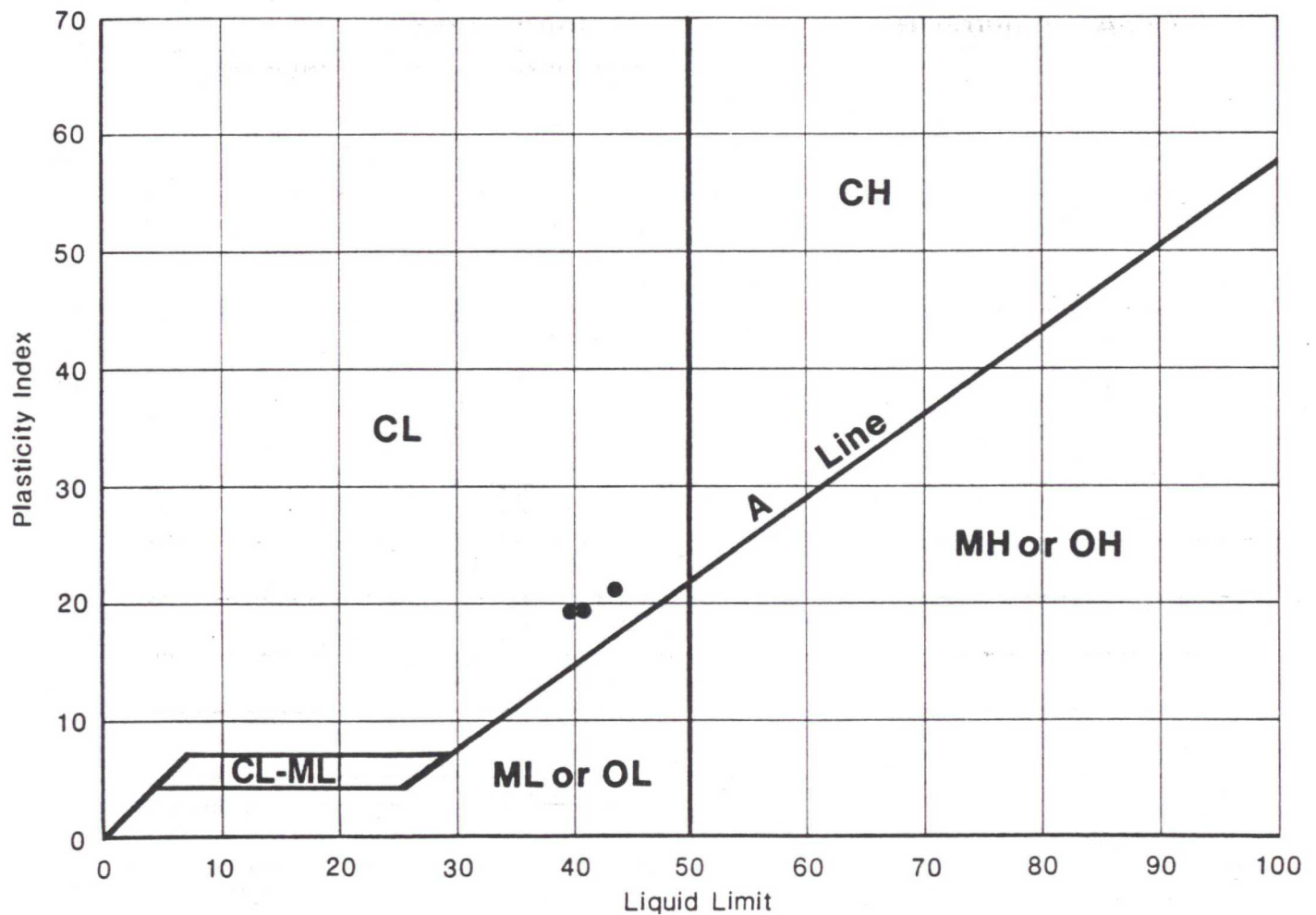
Plot of 28 Laboratory Tests

L.L. LIQUID LIMIT
P.L. PLASTIC LIMIT
P.I. PLASTICITY INDEX
USC UNIFIED SOIL CLASSIFICATION

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Figure B-3

Plasticity Chart

Type III SILT



SYMBOL	BORING NUMBER	SAMPLE NUMBER	DEPTH IN FEET	WATER CONTENT IN PERCENT				CLASSIFICATION	USC
				NAT.	L.L.	P.L.	P.I.		

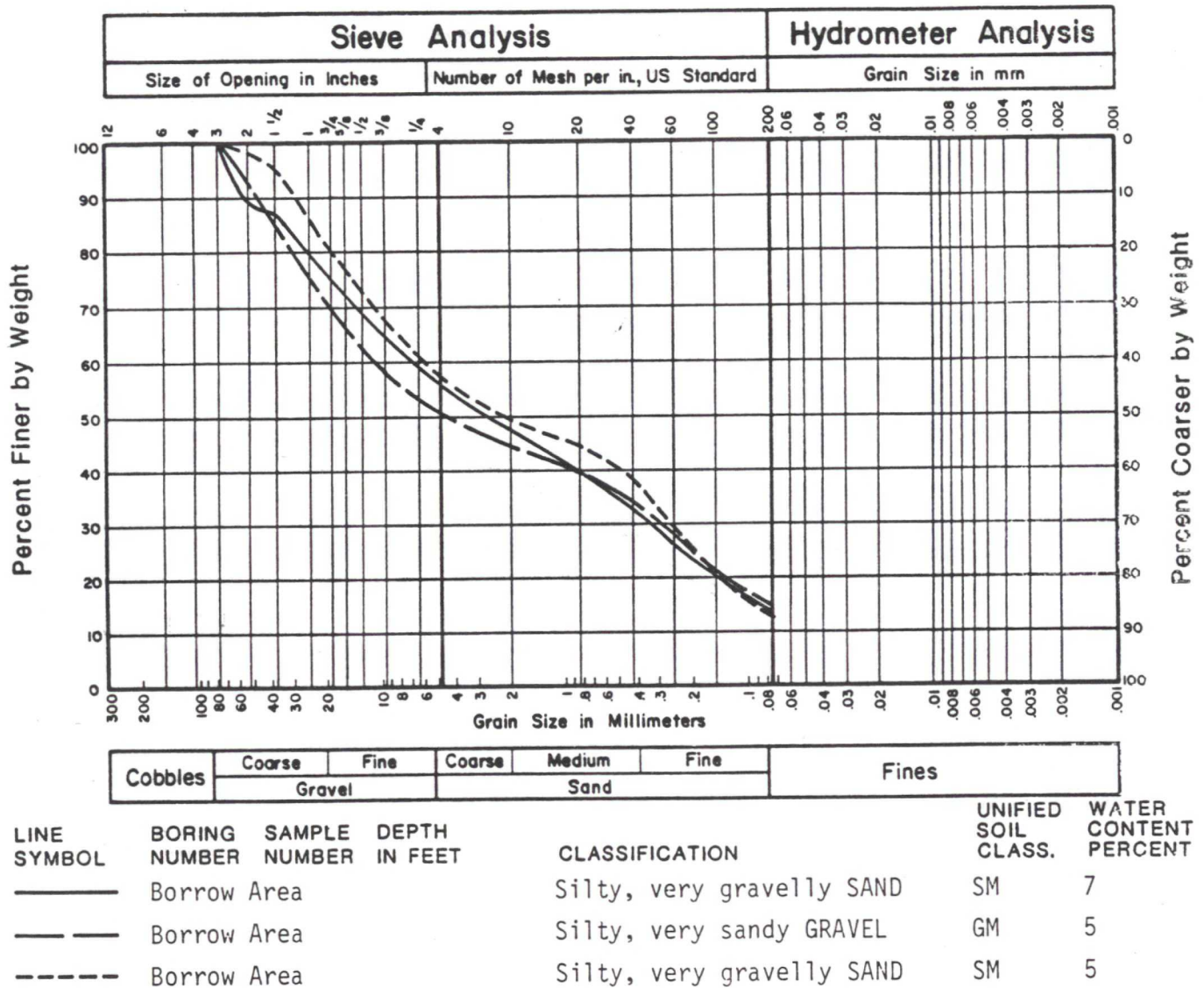
Plot of 3 Laboratory Tests

L.L. LIQUID LIMIT
P.L. PLASTIC LIMIT
P.I. PLASTICITY INDEX
USC UNIFIED SOIL CLASSIFICATION

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Figure B-4

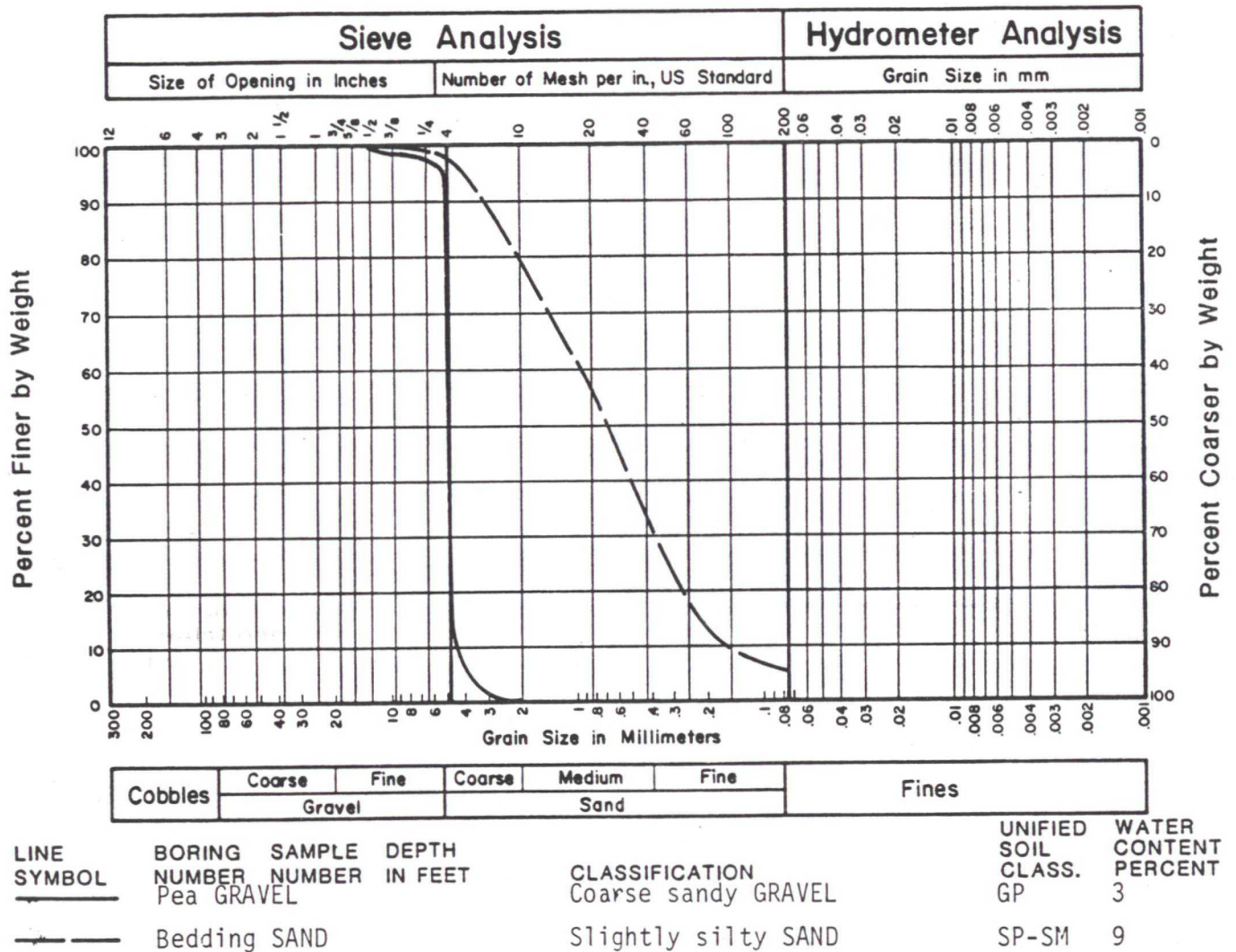
Grain Size Classification

Pond Backfill



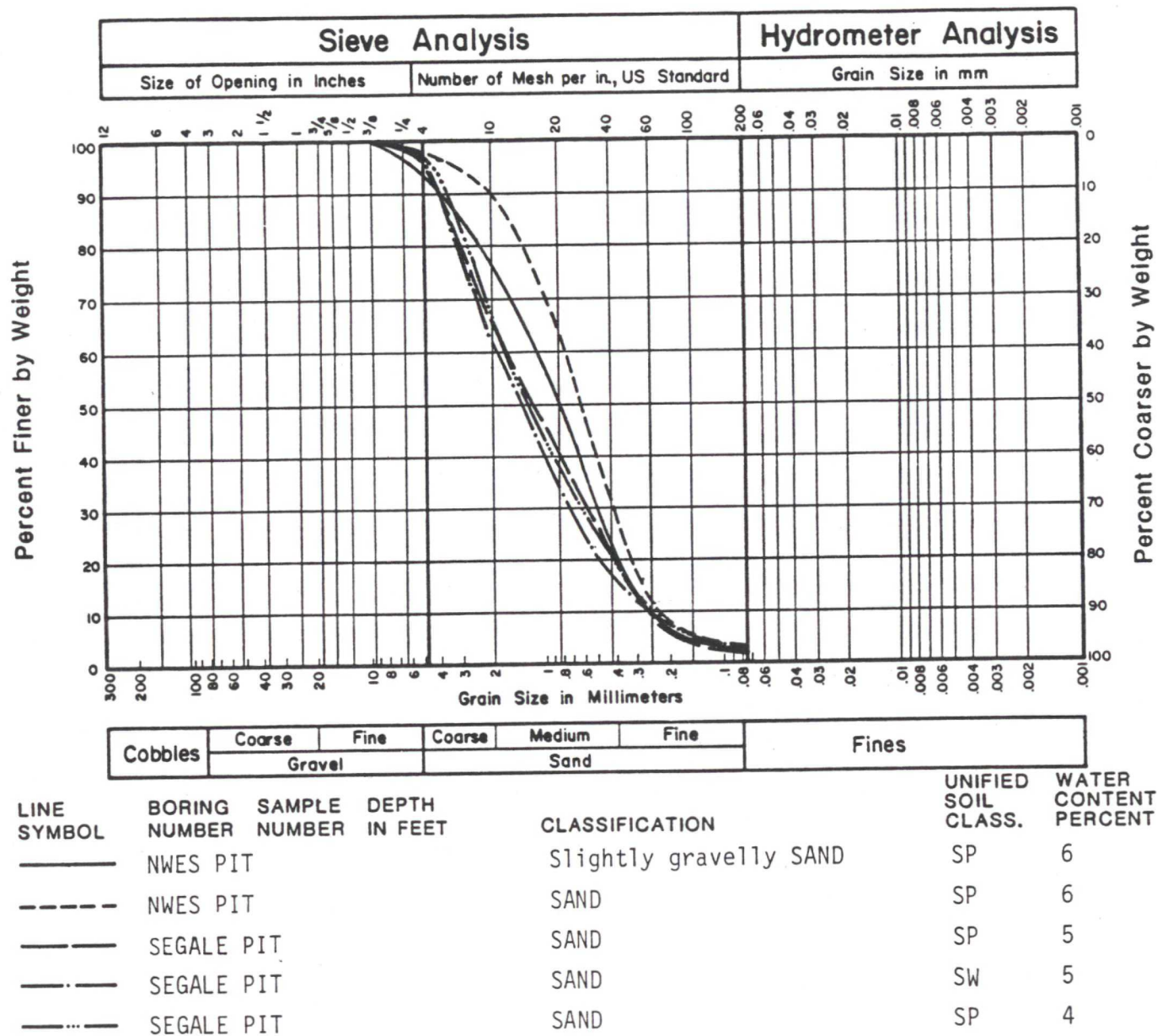
Grain Size Classification

Pea GRAVEL and Bedding SAND



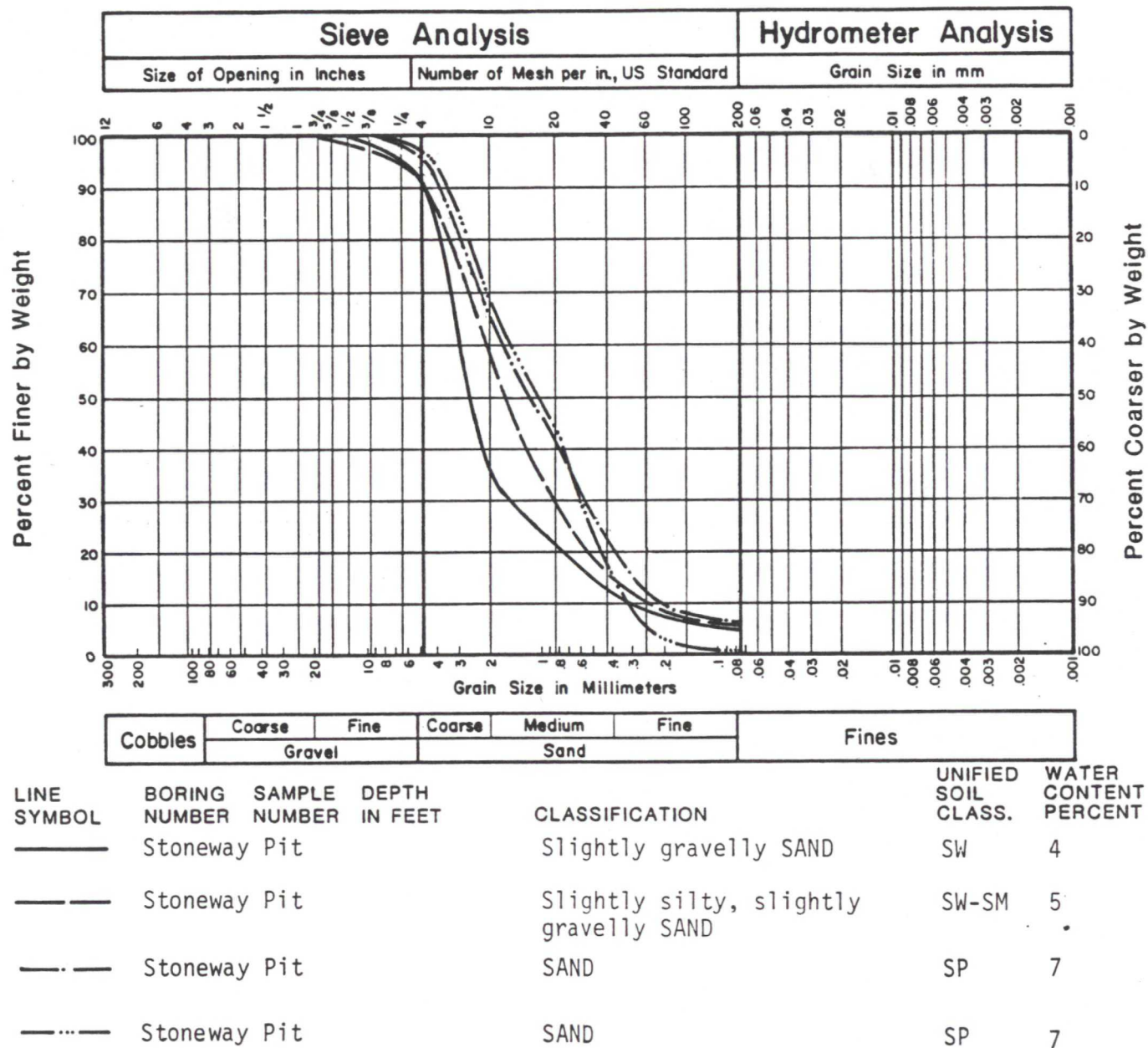
Grain Size Classification

Cover-SAND



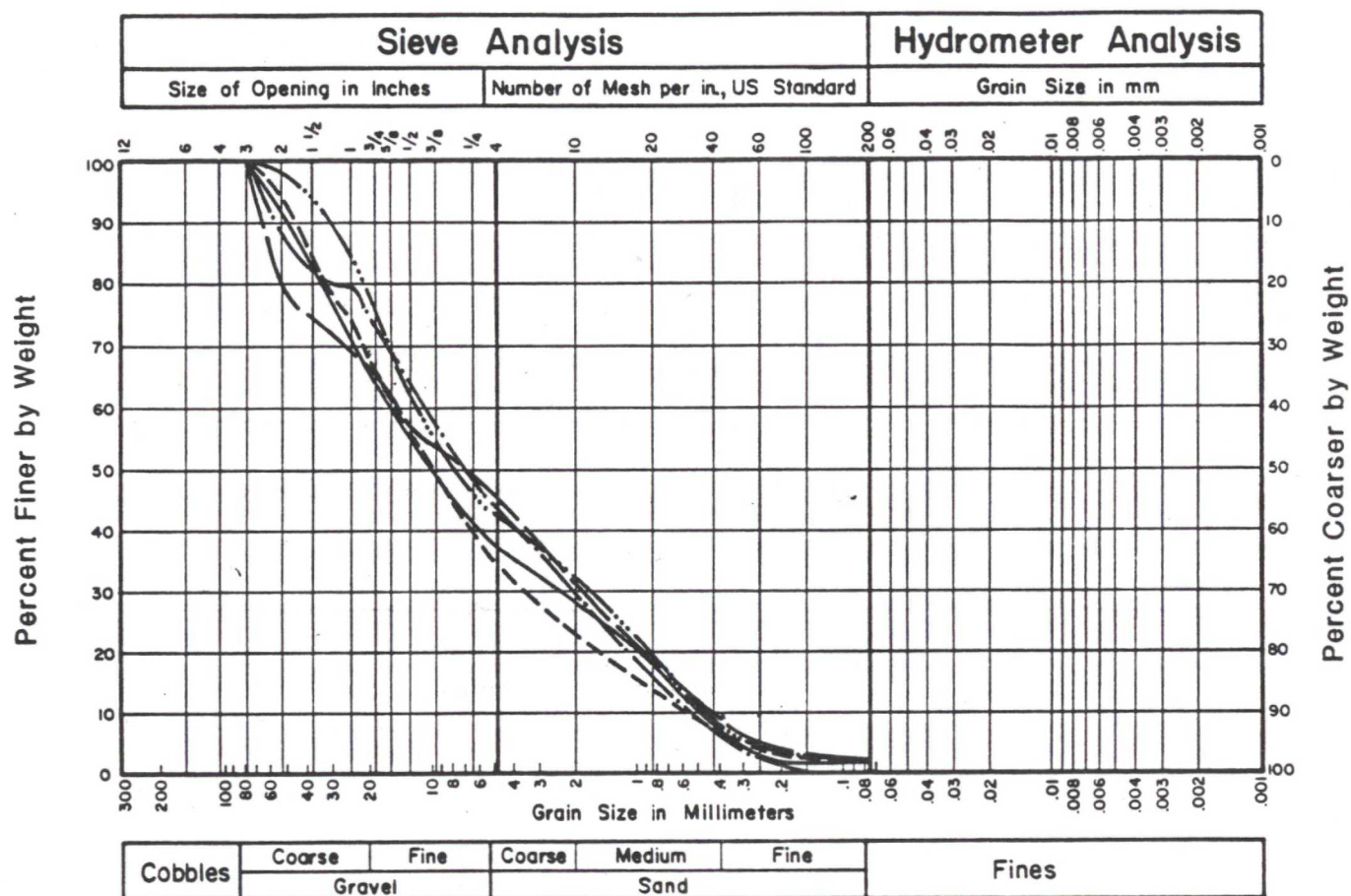
Grain Size Classification

Cover-SAND



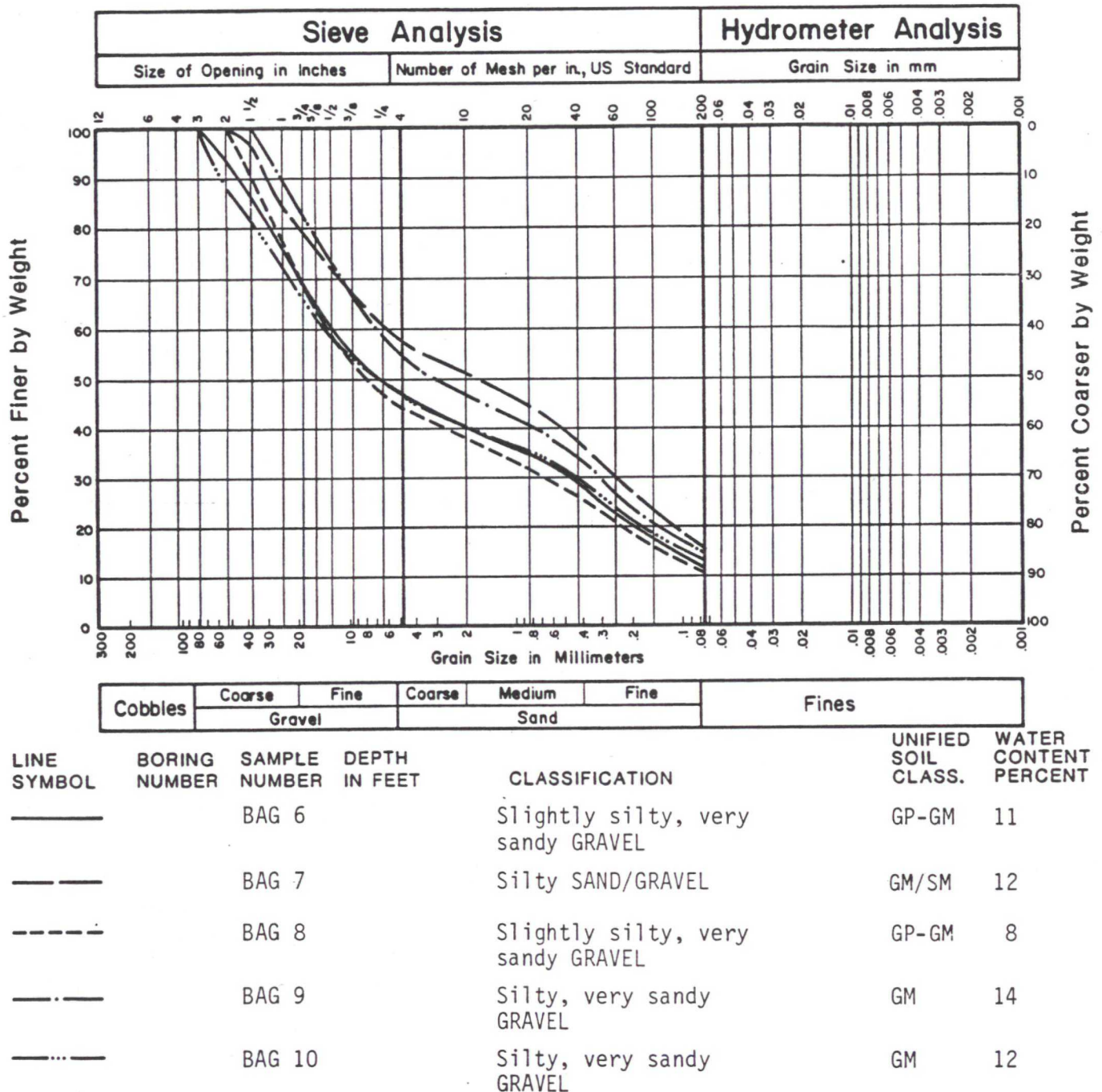
Grain Size Classification

Cover-SAND and GRAVEL

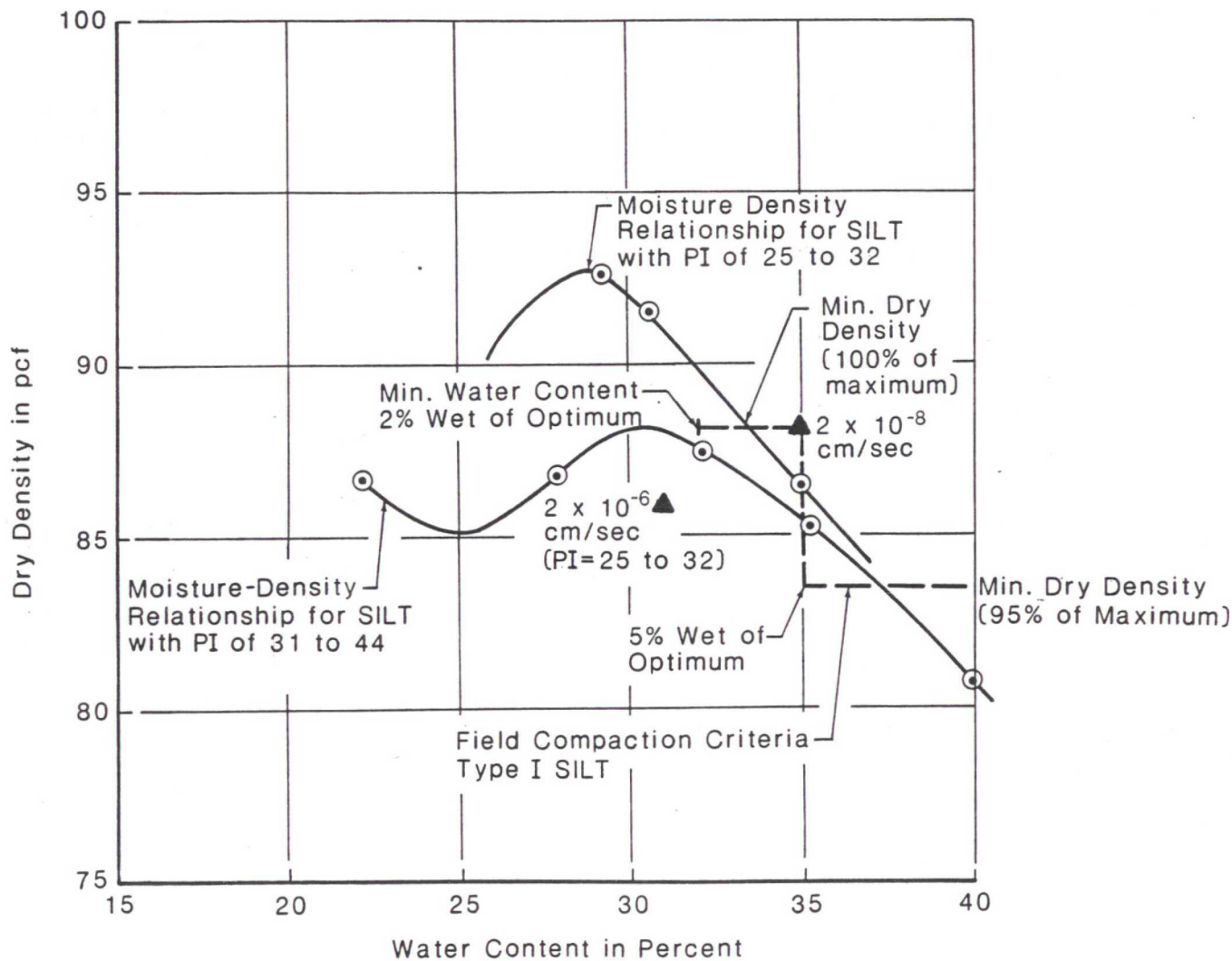


Grain Size Classification

Cover-Silty SAND and GRAVEL



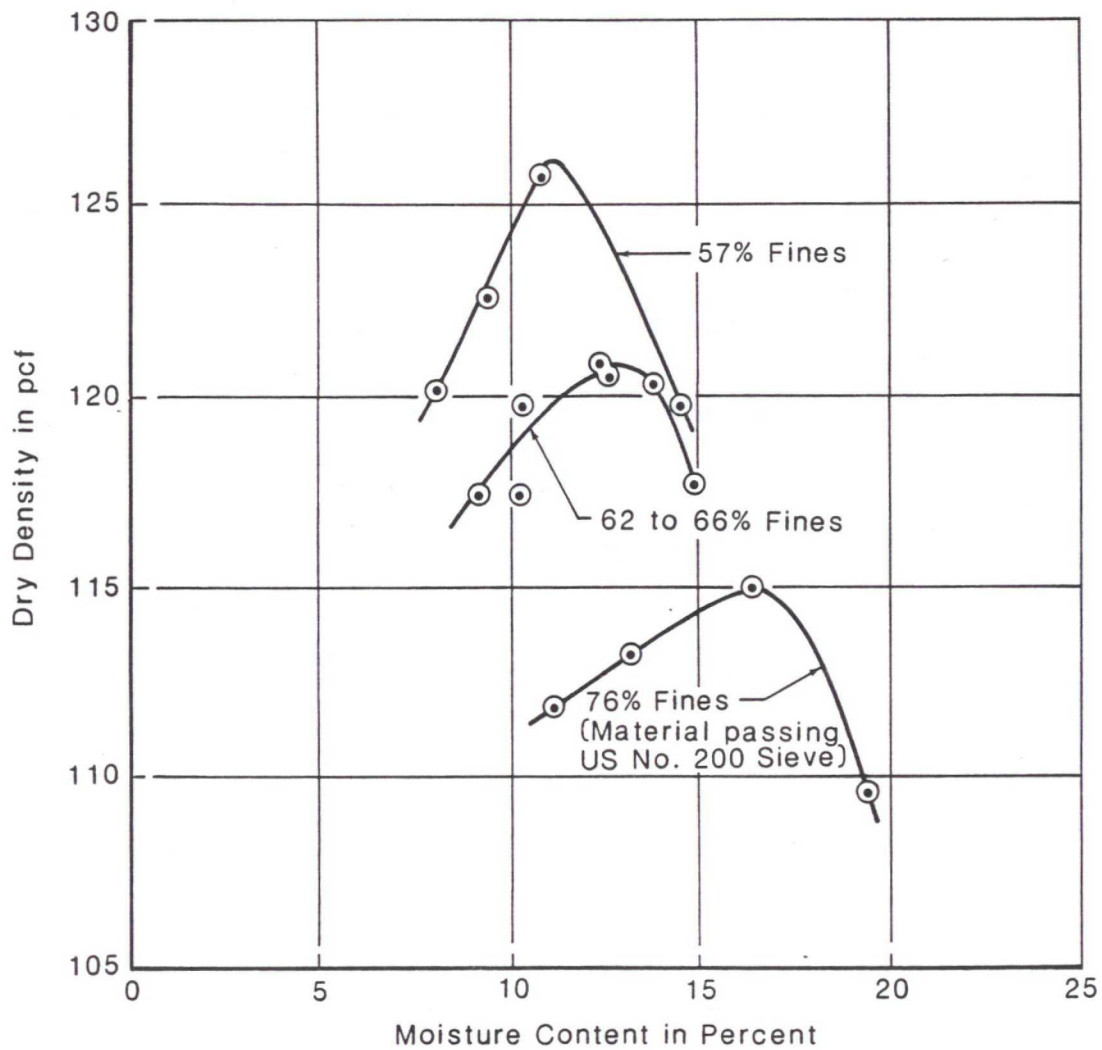
Laboratory Moisture-Density Relationships for Type I SILT



Notes: Standard Proctor Method (ASTM D698) was used for these tests.
Source of this SILT - Peter Kiewit Construction Company

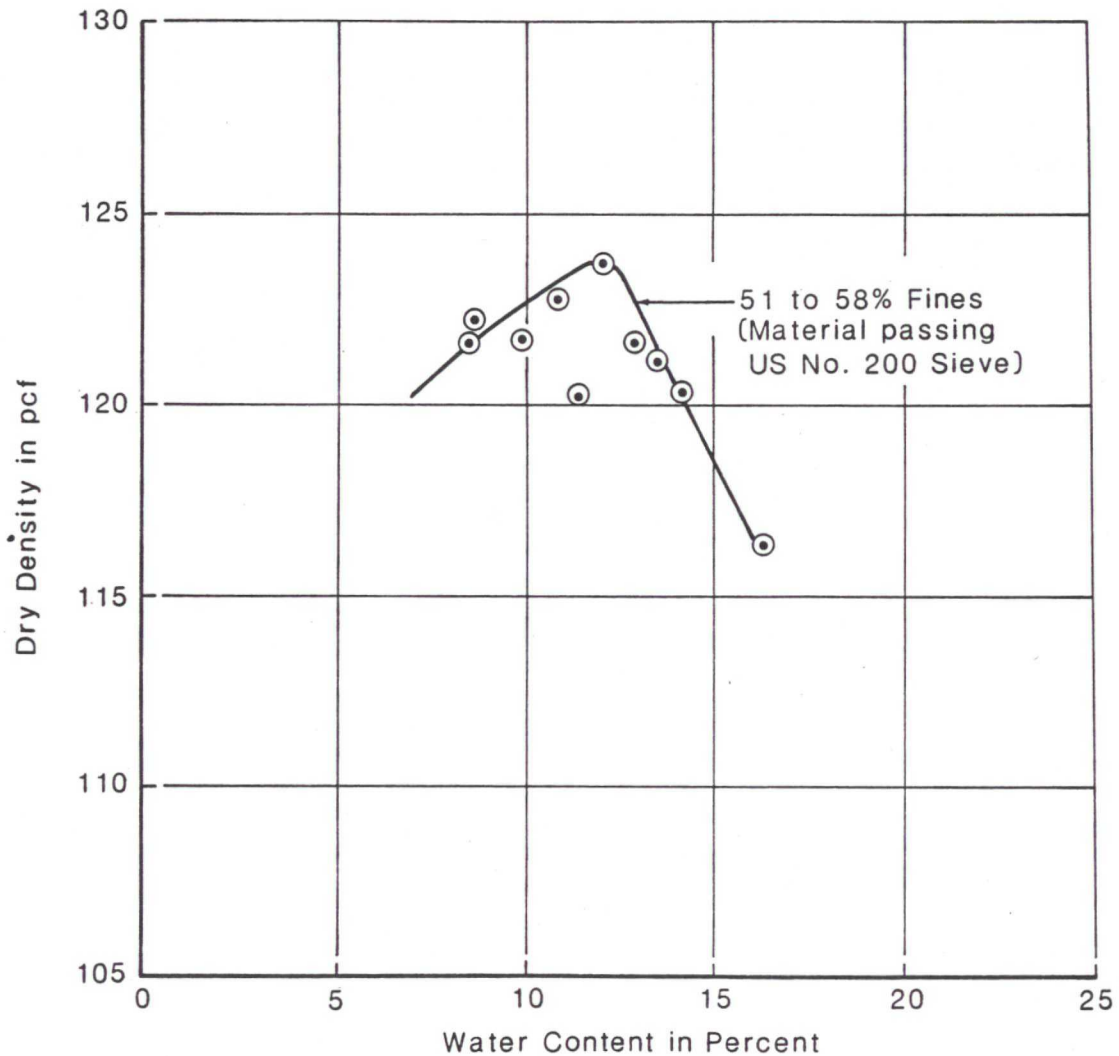
▲ = Results of Hydraulic Conductivity Tests in cm/sec.

Laboratory Moisture-Density Relationships for Type II SILT



Note: Source of this SILT-Fiorito Brothers Construction Company.
Standard Proctor Method (ASTM D 698) was used for these tests.

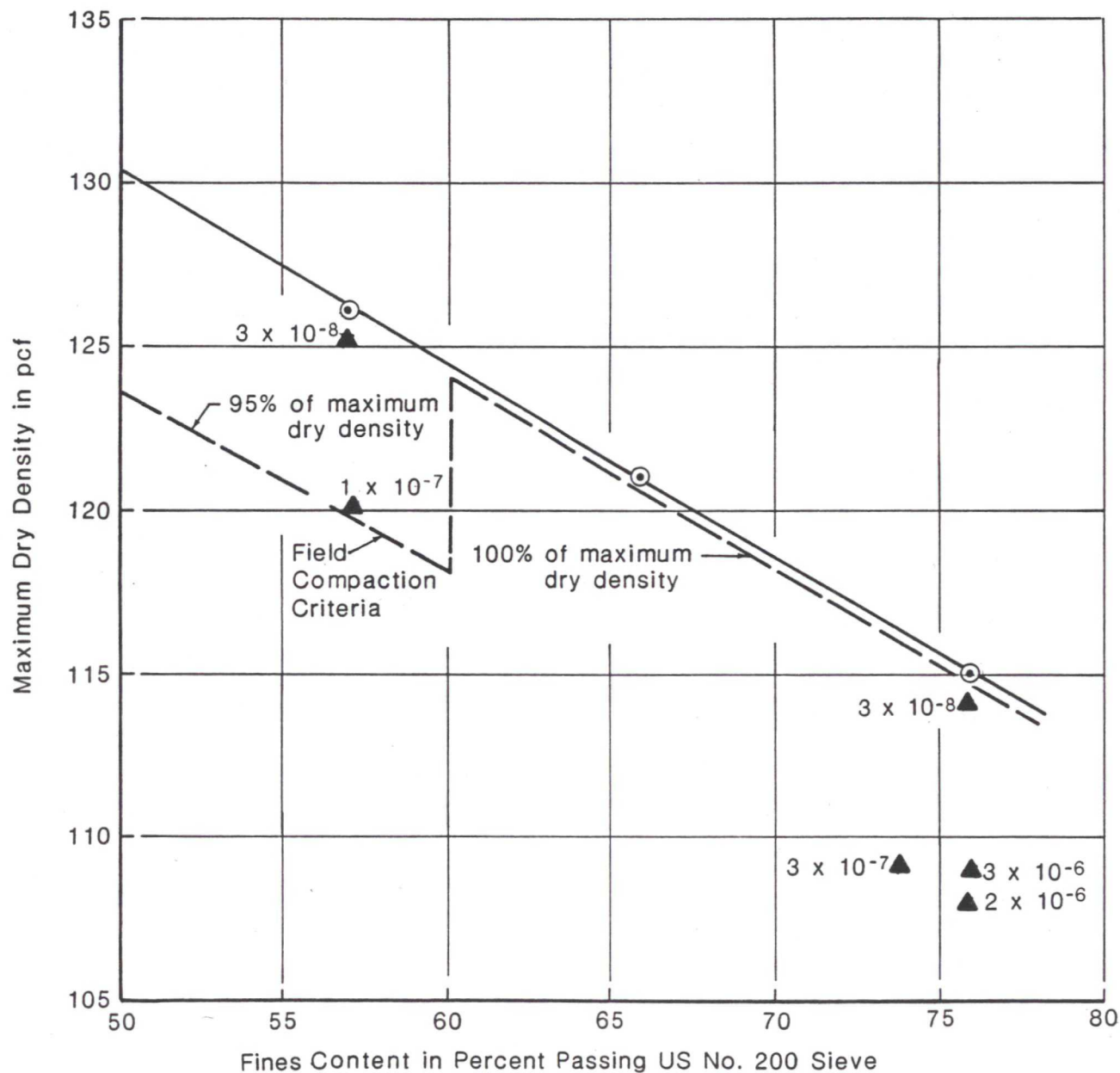
Laboratory Moisture-Density Relationships for Type II SILT



Note: Source of this SILT - Scarsella Brothers Construction Company
Standard Proctor Method (ASTM D 698) was used for these tests.

Correlative Plot of Laboratory Maximum Dry Density Versus Fines Contents

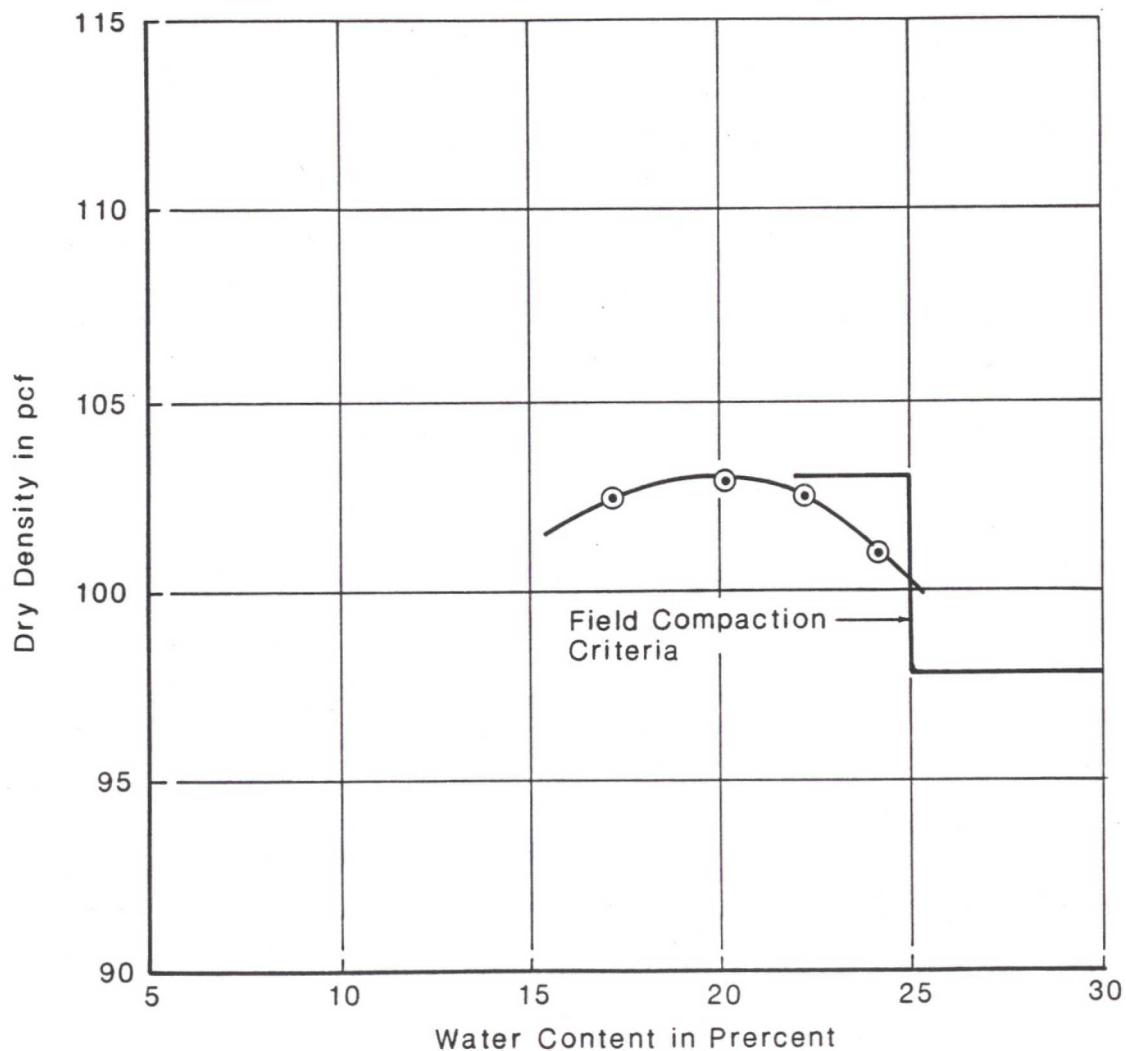
Type II SILT



Note: All Maximum dry density values are based on Standard Proctor Method (ASTM D 698 Method A) See Figures B-12 and B-13.

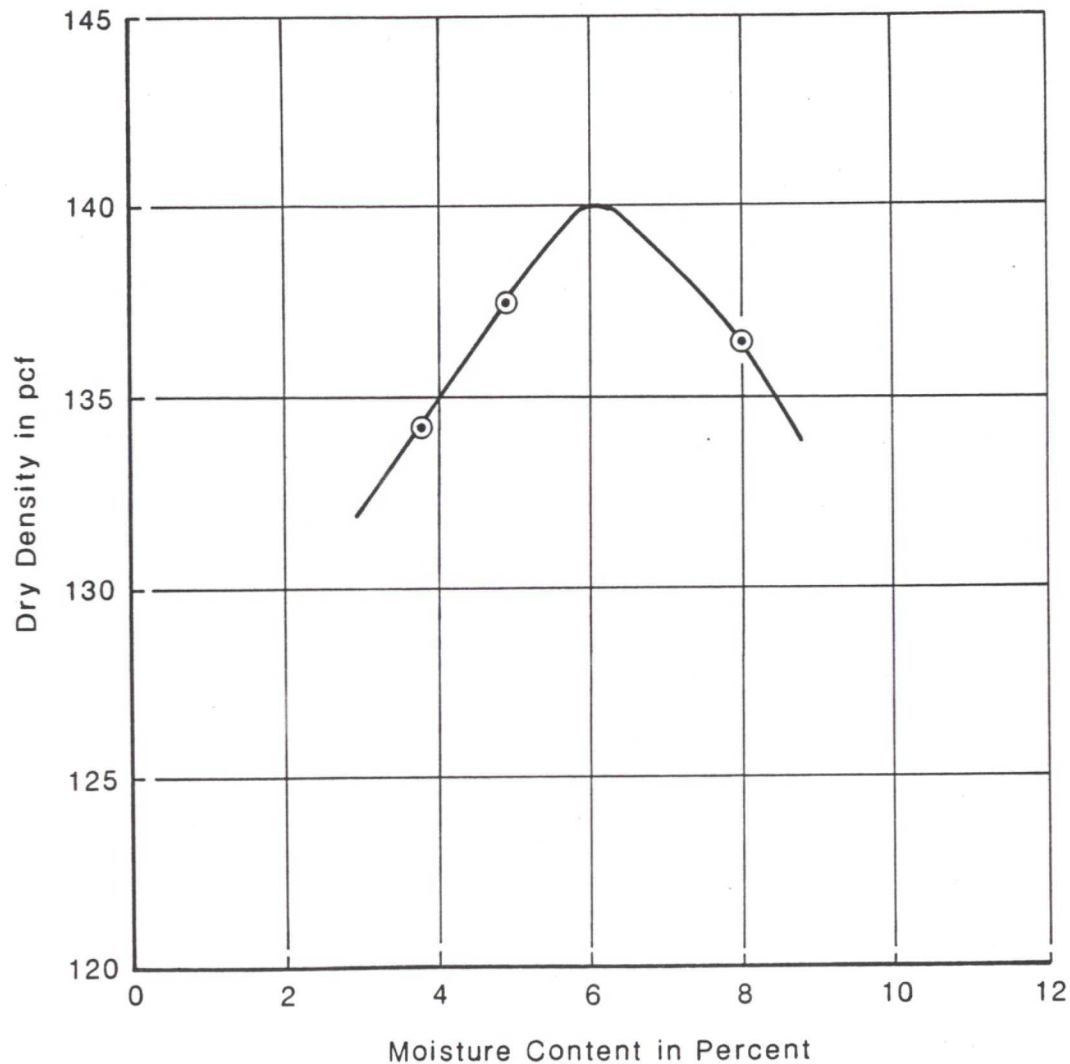
▲ = Results of Hydraulic Conductivity Tests in cm/sec.

Laboratory Moisture-Density Relationships for Type III SILT



Note: Source of this SILT-Fiorito Brothers Construction Company.
Standard Proctor Method (ASTM D 698) used for these tests.

Laboratory Moisture - Density Relationships for Sandy GRAVEL Placed over SILT Berm



Note: Source of this material Queen City Farms Borrow Area.
Standard Proctor Method (ASTM D 698) used for these tests.

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APPENDIX C

RESULTS OF LABORATORY CHEMICAL ANALYSES

Analyses of Soil by Laucks Laboratory

Laboratory reports including method references and quality control information are attached. Summary tables 1, 2, 3, and 4 in the text were derived from the information herein.

o Laucks Laboratory Report No. 96553	11 pages
o Laucks Laboratory Report No. 97424	10 pages
o Laucks Laboratory Report No. 97586	20 pages
o Laucks Laboratory Report No. 98243	11 pages
o Laucks Laboratory Report No. 98261	12 pages

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Chemistry, Microbiology, and Technical Services

CLIENT Hart Crowser
1910 Fairview Ave. E.
Seattle, WA 98102
ATTN: Phillip Spadaro

LABORATORY NO 96553

DATE June 4, 1986

Job #1264-05

REPORT ON SOIL

SAMPLE IDENTIFICATION Submitted 4/30/86 and identified as shown:

TESTS PERFORMED AND RESULTS:

- 1) S-1A 4/30 11:00 P-1
- 2) S-2A 4/30 11:00 P-1
- 3) S-3A 4/30 11:00 P-1
- 4) S-4A 4/30 11:00 P-1
- 5) S-5A 4/30 11:00 P-1
- 6) S-6A 4/30 11:00 P-1

Samples 1-6 were composited into one sample, designated sample "A".

Sample was analyzed for priority pollutants in accordance with Test Methods for Evaluating Solid Waste, (SW-846), U.S.E.P.A., 1982, Methods 8240 (volatile organics), 8270 (semi-volatile extractables), 8080 (pesticides and PCB's), 9010 (cyanide), and the 7000 series (metals analysis). Phenol analysis was in accordance with Method 420.2, Methods for Chemical Analysis of Water & Wastes, U.S.E.P.A., March, 1979.



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Inorganics

	<u>A</u>	<u>Lab Blank</u>
Total Solids, %	77.9	---
<u>parts per million (mg/kg), dry basis</u>		
Antimony	L/2.	L/2.
Arsenic	2.9	L/0.5
Beryllium	L/0.1	L/0.1
Cadmium	17.	L/0.5
Chromium	31,000.	L/1.
Copper	460.	L/1.
Lead	20.	L/10.
Mercury	0.3	L/0.1
Nickel	54.	L/2.
Selenium	L/0.5	L/0.5
Silver	0.6	L/0.1
Thallium	L/0.5	L/0.5
Zinc	91.	2.
Total Cyanide	38.	L/0.5
Total Phenol	150.	L/0.5
Barium	80.	L/40.



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Volatile Organics (by GC/MS)

parts per billion (ug/kg), dry basis

	<u>A</u>	<u>Lab Blank</u>
Chloromethane	L/5.	L/5.
Bromomethane	L/5.	L/5.
Vinyl Chloride	trace	L/5.
Chloroethane	L/5.	L/5.
Methylene Chloride	180,000.	trace
Acrolein	L/25.	L/25.
*Acetone	1900.	trace
Acrylonitrile	L/25.	L/25.
*Carbon Disulfide	L/5.	L/5.
1,1-Dichloroethylene	49.	L/5.
1,1-Dichloroethane	38.	L/5.
trans-1,2-Dichloroethylene	1300.	L/5.
Chloroform	290.	L/5.
*2-Butanone	150.	L/5.
1,2-Dichloroethane	43.	L/5.
1,1,1-Trichloroethane	1500.	L/5.
*Vinyl Acetate	L/5.	L/5.
Bromodichloromethane	L/5.	L/5.
Carbon Tetrachloride	L/5.	L/5.
1,2-Dichloropropane	190.	L/5.
Trichloroethylene	270,000.	L/5.
Benzene	380.	L/5.
Chlorodibromomethane	L/5.	L/5.
1,1,2-Trichloroethane	L/5.	L/5.
2-Chloroethyl vinyl ether	L/5.	L/5.
Bromoform	L/5.	L/5.
*4-Methyl-2-pentanone	L/5.	L/5.



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parts per billion (ug/kg), dry basis

	<u>A</u>	<u>Lab Blank</u>
*2-Hexanone	L/5.	L/5.
1,1,2,2-Tetrachloroethane	L/5.	L/5.
Tetrachloroethylene	1900.	L/5.
Toluene	40,000.	L/5.
Chlorobenzene	L/5.	L/5.
trans-1,3-Dichloropropene	L/5.	L/5.
Ethylbenzene	6200.	L/5.
cis-1,3-Dichloropropene	L/5.	L/5.
*Styrene	L/5.	L/5.
*o-Xylene	38,000.	L/5.

Extractables (by GC/MS)

parts per million (mg/kg), dry basis

	<u>A</u>	<u>Lab Blank</u>
N-nitrosodimethylamine	L/3.5	L/1.0
Bis(2-chloroethyl)ether	L/3.5	L/1.0
2-Chlorophenol	L/3.5	L/1.0
Phenol	L/3.5	L/1.0
1,3-Dichlorobenzene	L/3.5	L/1.0
1,4-Dichlorobenzene	L/3.5	L/1.0
1,2-Dichlorobenzene	L/3.5	L/1.0
Bis(2-chloroisopropyl)ether	L/3.5	L/1.0
Hexachloroethane	L/3.5	L/1.0
N-nitroso-di-n-propylamine	L/3.5	L/1.0



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parts per million (mg/kg), dry basis

	<u>A</u>	<u>Lab Blank</u>
Nitrobenzene	L/3.5	L/1.0
Isophorone	L/3.5	L/1.0
2-Nitrophenol	L/3.5	L/1.0
2,4-Dimethylphenol	8.1	L/1.0
Bis(2-chloroethoxy)methane	L/3.5	L/1.0
2,4-Dichlorophenol	L/3.5	L/1.0
1,2,4-Trichlorobenzene	L/3.5	L/1.0
Naphthalene	L/3.5	L/1.0
Hexachlorobutadiene	L/3.5	L/1.0
4-Chloro-m-cresol	L/3.5	L/1.0
Hexachlorocyclopentadiene	L/3.5	L/1.0
2,4,6-Trichlorophenol	L/3.5	L/1.0
2-Chloronaphthalene	L/3.5	L/1.0
Acenaphthylene	L/3.5	L/1.0
Dimethylphthalate	L/3.5	L/1.0
2,6-Dinitrotoluene	L/3.5	L/1.0
Acenaphthene	3.7	L/1.0
2,4-Dinitrophenol	L/3.5	L/1.0
2,4-Dinitrotoluene	L/3.5	L/1.0
4-Nitrophenol	L/3.5	L/1.0
Fluorene	5.8	L/1.0
4-Chlorophenyl phenyl ether	L/3.5	L/1.0
Diethylphthalate	L/3.5	L/1.0
4,6-Dinitro-o-cresol	L/3.5	L/1.0
1,2-Diphenylhydrazine	L/3.5	L/1.0
4-Bromophenyl phenyl ether	L/3.5	L/1.0
Hexachlorobenzene	L/3.5	L/1.0
Pentachlorophenol	L/3.5	L/1.0
Phenanthrene	33.	L/1.0
Anthracene	L/3.5	L/1.0



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PAGE NO. 6

LABORATORY NO. 96553

Hart Crowser

parts per million (mg/kg), dry basis

	<u>A</u>	<u>Lab Blank</u>
Dibutylphthalate	L/3.5	L/1.0
Fluoranthene	L/3.5	L/1.0
Pyrene	7.9	L/1.0
Benzidine	L/3.5	L/1.0
Butyl benzyl phthalate	L/3.5	L/1.0
Benzo(a)anthracene	L/3.5	L/1.0
Chrysene	4.5	L/1.0
3,3'-Dichlorobenzidine	L/3.5	L/1.0
Bis(2-ethylhexyl)phthalate	L/3.5	L/1.0
N-nitrosodiphenylamine	L/3.5	L/1.0
Di-n-octyl phthalate	L/3.5	L/1.0
Benzo(b)fluoranthene	L/3.5	L/1.0
Benzo(k)fluoranthene	L/3.5	L/1.0
Benzo(a)pyrene	L/3.5	L/1.0
Indeno(1,2,3-cd)pyrene	L/3.5	L/1.0
Dibenzo(ah)anthracene	L/3.5	L/1.0
Benzo(ghi)perylene	L/3.5	L/1.0
*Aniline	L/3.5	L/1.0
*Benzoic Acid	L/3.5	L/1.0
*Benzyl Alcohol	L/3.5	L/1.0
*4-Chloroaniline	L/3.5	L/1.0
*Dibenzofuran	L/3.5	L/1.0
*2-Methylnaphthalene	63.	L/1.0
*2-Methylphenol	L/3.5	L/1.0
*4-Methylphenol	L/3.5	L/1.0
*2-Nitroaniline	L/3.5	L/1.0
*3-Nitroaniline	L/3.5	L/1.0
*4-Nitroaniline	L/3.5	L/1.0
*2,4,5-Trichlorophenol	L/3.5	L/1.0



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Pesticides (by GC/ECD)

parts per billion (ug/kg), dry basis

	<u>A</u>	<u>Lab Blank</u>
alpha-BHC	L/100.	L/100.
beta-BHC	L/100.	L/100.
delta-BHC	L/100.	L/100.
gamma-BHC (lindane)	L/100.	L/100.
heptachlor	L/100.	L/100.
aldrin	L/100.	L/100.
heptachlor epoxide	L/100.	L/100.
dieldrin	L/100.	L/100.
4,4'-DDE	L/100.	L/100.
4,4'-DDD	L/200.	L/200.
endosulfan sulfate	L/200.	L/200.
4,4'-DDT	L/200.	L/200.
chlordan	L/200.	L/200.
alpha endosulfan	L/200.	L/200.
beta endosulfan	L/200.	L/200.
endrin	L/200.	L/200.
endrin aldehyde	L/200.	L/200.
toxaphene	L/2000.	L/2000.
PCB 1016	L/1000.	L/1000.
PCB 1221	L/1000.	L/1000.
PCB 1232	L/1000.	L/1000.
PCB 1242	L/1000.	L/1000.
PCB 1248	L/1000.	L/1000.
PCB 1254	4900.	L/1000.
PCB 1260	4700.	L/1000.
Methoxychlor	L/400.	L/400.
Endrin Ketone	L/200.	L/200.



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The sample was also extracted in accordance with Test Methods for Evaluating Solid Wastes, (SW 846), U.S.E.P.A., July, 1982, Method 1310. The extract was then analyzed for priority pollutants in accordance with Methods 8080 and 8150 (pesticides and herbicides), and the 7000 series/6010 (metals analysis).

Inorganics

parts per million (mg/L)

	<u>A</u>	<u>Lab Blank</u>
Antimony	L/0.2	L/0.2
Arsenic	L/0.2	L/0.2
Beryllium	L/0.01	L/0.01
Cadmium	L/0.02	L/0.02
Chromium	1.7	L/0.1
Copper	L/0.1	L/0.1
Lead	L/0.1	L/0.1
Mercury	L/0.005	L/0.005
Nickel	L/0.1	L/0.1
Selenium	L/0.2	L/0.2
Silver	L/0.1	L/0.1
Thallium	L/2.	L/2.
Zinc	0.1	L/0.1
Barium	L/0.1	L/0.1

parts per million (mg/L)

	<u>A</u>
Endrin	L/0.001
Methoxychlor	L/0.005
Toxaphene	L/0.025
2,4-D	L/0.002
2,4,5-TP	L/0.001
Lindane	L/0.0005



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Comment

Methylene chloride and acetone are common solvents in everyday use at the laboratory. A contribution may be made to the values shown in this report through unavoidable laboratory contamination. Although blank values are considerably less than sample results, it is our experience that soils in the lab may absorb large amounts of the these compounds. Precisely what contribution is made by the lab cannot be determined.

The other compounds for which there are detectable levels reported would be expected to be native to the sample.

Key

L/ indicates "less than"

* indicates additional compounds from the EPA's Hazardous Substances List.
trace indicates an unquantifiable amount between 5-25 parts per billion.

Respectfully submitted,

Laucks Testing Laboratories, Inc.

J. M. Owens
J. M. Owens

JMO:veg



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APPENDIX

Surrogate Recovery Quality Control Report

Listed below are surrogate (chemically similar) compounds utilized in the analysis of volatile and organic compounds. The surrogates are added to every sample prior to extraction and analysis to monitor for matrix effects, purging efficiency, and sample processing errors. The control limits represent the 95% confidence interval established in our laboratory through repetitive analysis of these sample types.

<u>Sample No.</u>	<u>Surrogate Compound</u>	<u>Spike Level</u>	<u>Spike Found</u>	<u>% Recovery</u>	<u>Control Limit</u>
<u>parts per billion (ug/kg)</u>					
Blank	d4-1,2-Dichloroethane	50.0	45.1	90.2	50-160
	d8-Toluene	50.0	49.8	99.6	50-160
	p-Bromofluorobenzene	50.0	48.6	97.2	50-160
A	d4-1,2-Dichloroethane	8730.	7890.	90.4	50-160
	d8-Toluene	8730.	8640.	99.0	50-160
	p-Bromofluorobenzene	8730.	9860.	113.	50-160
Blank	Isodrin	500.	249.	49.8	48-118
A	Isodrin	500.	278.	55.6	48-118
Blank	Dibutylchlorendate	1000.	500.	50.0	20-154
A	Dibutylchlorendate	1000.	494.	49.4	20-154



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<u>Sample No.</u>	<u>Surrogate Compound</u>	<u>Spike Level</u>	<u>Spike Found</u>	<u>% Recovery</u>	<u>Control Limit</u>
<u>parts per billion (ug/L)</u>					
Blank	Isodrin	0.0050	0.00367	73.4	43-118
A	Isodrin	0.0050	0.00168	33.7	43-118
A ext.	Isodrin	0.0050	0.00470	93.9	43-118
Blank	Dibutylchloredate	0.010	0.00714	71.4	24-150
A	Dibutylchloredate	0.010	0.00669	66.9	24-150
A ext.	Dibutylchloredate	0.010	0.00630	63.0	24-150
<u>parts per million (mg/L)</u>					
Blank	2,4,5-T	0.010	0.0066	66.0	28-128
1	2,4,5-T	0.010	0.0063	62.8	28-128



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Laucks Testing Laboratories, Inc.

Sample Type: Soil
 Lab No: 96553
 Client: Hart Crowser
 QC Logged: 6/2/86

Surrogate Recovery Quality Control Report

Listed below are surrogate (chemically similar) compounds utilized in the analysis of organic compounds. The surrogates are added to every sample prior to extraction to monitor for matrix effects and sample processing errors. The control limits represent the 95% confidence interval established in our laboratory through repetitive analysis of these sample types. In certain cases, we will have accumulated insufficient data to have established control limits.

=====				
Sample Number: Blank		Reported Values in Units of: ug/g		

Surrogate Compound	Spike Level	Spike Detected	Percent Recovery	Control Limits
=====				
2-Fluorophenol	233	210	90	24-133
d5-Phenol	233	200	86	20-122
2-Bromophenol	233	180	77	---
d5-Nitrobenzene	116	95	82	20-140
2-Fluorobiphenyl	116	100	86	20-140
2,4,6-Tribromophenol	233	220	94	10-114
d14-p-Terphenyl	116	190	164	20-150

=====				
Sample Number: 1		Reported Values in Units of: ug/g		

Surrogate Compound	Spike Level	Spike Detected	Percent Recovery	Control Limits
=====				
2-Fluorophenol	223	180	81	24-133
d5-Phenol	223	190	85	20-122
2-Bromophenol	223	170	76	---
d5-Nitrobenzene	116	75	65	20-140
2-Fluorobiphenyl	116	100	86	20-140
2,4,6-Tribromophenol	223	220	99	10-114
d14-p-Terphenyl	116	110	95	20-150

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CLIENT Hart Crowser
1910 Fairview Avenue East
Seattle, WA 98102
ATTN: Phillip Spadaro

LABORATORY NO. 97424

DATE Aug. 1, 1986

JOB# 1264-06

REPORT ON SOIL

Submitted 6/30/86 and identified as shown below:

SAMPLE
IDENTIFICATION

TESTS PERFORMED
AND RESULTS:

1) S-1A	P-2	P.A.S.	6/27/86	15:00	1264-06
2) S-2A	P-2	P.A.S.	6/27/86	15:00	1264-06
3) S-3A	P-2	P.A.S.	6/27/86	15:00	1264-06
4) S-4A	P-2	P.A.S.	6/27/86	15:00	1264-06
5) S-5A	P-2	P.A.S.	6/27/86	15:00	1264-06
6) S-6A	P-2	P.A.S.	6/27/86	15:00	1264-06

Samples were composited on a equal weight basis and identified as Composite A.

Sample was analyzed for E.P. Toxicity in accordance with Test Methods for Evaluating Solid Waste, (SW 846), U.S.E.P.A., July, 1982. Extraction was performed using Method 1310. Metals performed by ICAP, Method 6010 and the 7000 series.

parts per million (mg/L)

	<u>A</u>
Arsenic	L/0.2
Barium	0.1
Cadmium	0.06
Chromium	5.5
Lead	0.1
Mercury	0.042
Selenium	L/0.2
Silver	L/0.1
Antimony	L/0.2
Beryllium	L/0.01
Copper	0.6
Nickel	0.3
Thallium	L/2.
Zinc	0.4



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Sample was analyzed for priority pollutants in accordance with Test Methods for Evaluating Solid Waste, (SW-846), U.S.E.P.A., 1982, Methods 8240 (volatile organics), 8270 (semi-volatile extractables), 8080 (pesticides and PCB's), 9010 (cyanide), 6010 (ICP) and the 7000 series (metals analysis). Phenol analysis was in accordance with Method 420.2, Methods for Chemical Analysis of Water & Wastes, U.S.E.P.A., March, 1979.

<u>Inorganics</u>	<u>A</u>	<u>Method Blank</u>
Total Solids, %	81.3	---
<u>parts per million (mg/kg), dry basis</u>		
Antimony	L/3.	L/3.
Arsenic	24.	L/0.5
Beryllium	0.3	L/0.1
Cadmium	3.8	L/0.5
Chromium	15,000.	L/1.
Copper	170.	L/1.
Lead	72.	L/10.
Mercury	0.3	L/0.1
Nickel	37.	L/2.
Selenium	L/0.5	L/0.5
Silver	0.5	L/0.1
Thallium	L/0.5	L/0.5
Zinc	54.	L/1.
Total Cyanide	14.	L/0.5
Total Phenol	14.	L/0.5
Barium	66.	L/2.
Total Solids	81.3	---



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parts per billion (ug/kg), dry basis

<u>Volatile Organics (by GC/MS)</u>	<u>A</u>	<u>Method Blank</u>
Chloromethane	L/2,500.	L/5.
Bromomethane	L/2,500.	L/5.
Vinyl Chloride	L/2,500.	L/5.
Chloroethane	L/2,500.	L/5.
Methylene Chloride	36,000.	L/5.
Acrolein	L/2,500.	L/25.
*Acetone	18,000.	L/5.
Acrylonitrile	L/2,500.	L/25.
*Carbon Disulfide	L/2,500.	L/5.
1,1-Dichloroethylene	L/2,500.	L/5.
1,1-Dichloroethane	L/2,500.	L/5.
trans-1,2-Dichloroethylene	L/2,500.	L/5.
Chloroform	L/2,500.	L/5.
*2-Butanone	L/2,500.	L/5.
1,2-Dichloroethane	L/2,500.	L/5.
1,1,1-Trichloroethane	L/2,500.	L/5.
*Vinyl Acetate	L/2,500.	L/5.
Bromodichloromethane	L/2,500.	L/5.
Carbon Tetrachloride	L/2,500.	L/5.
1,2-Dichloropropane	L/2,500.	L/5.



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LABORATORY NO. 97424

parts per billion (ug/kg), dry basis

<u>Volatile Organics (by GC/MS)</u>	<u>A</u>	<u>Method Blank</u>
Trichloroethylene	670,000.	L/5.
Benzene	L/2,500.	L/5.
Chlorodibromomethane	L/2,500.	L/5.
1,1,2-Trichloroethane	L/2,500.	L/5.
2-Chloroethyl vinyl ether	L/2,500.	L/5.
Bromoform	L/2,500.	L/5.
*4-Methyl-2-pentanone	L/2,500.	L/5.
*2-Hexanone	L/2,500.	L/5.
1,1,2,2-Tetrachloroethane	L/2,500.	L/5.
Tetrachloroethylene	L/2,500.	L/5.
Toluene	23,000.	L/5.
Chlorobenzene	L/2,500.	L/5.
trans-1,3-Dichloropropene	L/2,500.	L/5.
Ethylbenzene	trace	L/5.
cis-1,3-Dichloropropene	L/2,500.	L/5.
*Styrene	trace	L/5.
*Total Xylene	24,000.	L/5.



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parts per million (mg/kg), dry basis

<u>Extractables (by GC/MS)</u>	<u>A</u>	<u>Method</u> <u>Blank</u>
N-nitrosodimethylamine	L/4.0	L/1.5
Bis(2-chloroethyl)ether	L/4.0	L/1.5
2-Chlorophenol	L/4.0	L/1.5
Phenol	7.4	L/1.5
1,3-Dichlorobenzene	L/4.0	L/1.5
1,4-Dichlorobenzene	L/4.0	L/1.5
1,2-Dichlorobenzene	L/4.0	L/1.5
Bis(2-chloroisopropyl)ether	L/4.0	L/1.5
Hexachloroethane	L/4.0	L/1.5
N-nitroso-di-n-propylamine	L/4.0	L/1.5
Nitrobenzene	L/4.0	L/1.5
Isophorone	L/4.0	L/1.5
2-Nitrophenol	L/4.0	L/1.5
2,4-Dimethylphenol	L/4.0	L/1.5
Bis(2-chloroethoxy)methane	L/4.0	L/1.5
2,4-Dichlorophenol	L/4.0	L/1.5
1,2,4-Trichlorobenzene	L/4.0	L/1.5
Naphthalene	37.	L/1.5
Hexachlorobutadiene	L/4.0	L/1.5
4-Chloro-m-cresol	L/4.0	L/1.5
Hexachlorocyclopentadiene	L/4.0	L/1.5
2,4,6-Trichlorophenol	L/4.0	L/1.5
2-Chloronaphthalene	L/4.0	L/1.5
Acenaphthylene	L/4.0	L/1.5
Dimethylphthalate	L/4.0	L/1.5



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parts per million (mg/kg), dry basis

<u>Extractables (by GC/MS)</u>	<u>A</u>	<u>Method</u> <u>Blank</u>
2,6-Dinitrotoluene	L/4.0	L/1.5
Acenaphthene	11.	L/1.5
2,4-Dinitrophenol	L/4.0	L/1.5
2,4-Dinitrotoluene	L/4.0	L/1.5
4-Nitrophenol	L/4.0	L/1.5
Fluorene	8.0	L/1.5
4-Chlorophenyl phenyl ether	L/4.0	L/1.5
Diethylphthalate	L/4.0	L/1.5
4,6-Dinitro-o-cresol	L/4.0	L/1.5
1,2-Diphenylhydrazine	L/4.0	L/1.5
4-Bromophenyl phenyl ether	L/4.0	L/1.5
Hexachlorobenzene	L/4.0	L/1.5
Pentachlorophenol	L/4.0	L/1.5
Phenanthrene	46.	L/1.5
Anthracene	8.4	L/1.5
Dibutylphthalate	L/4.0	L/1.5
Fluoranthene	L/4.0	L/1.5
Pyrene	9.8	L/1.5
Benzidine	L/4.0	L/1.5
Butyl benzyl phthalate	L/4.0	L/1.5
Benzo(a)anthracene	L/4.0	L/1.5
Chrysene	6.5	L/1.5
3,3'-Dichlorobenzidine	L/4.0	L/1.5
Bis(2-ethylhexyl)phthalate	5.2	L/1.5
N-nitrosodiphenylamine	L/4.0	L/1.5
Di-n-octyl phthalate	L/4.0	L/1.5



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Hart Crowser

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parts per million (mg/kg), dry basis

Extractables (by GC/MS)

	<u>A</u>	<u>Method</u> <u>Blank</u>
Benzo(b)fluoranthene	L/4.0	L/1.5
Benzo(k)fluoranthene	L/4.0	L/1.5
Benzo(a)pyrene	L/4.0	L/1.5
Indeno(1,2,3-cd)pyrene	L/4.0	L/1.5
Dibenzo(ah)anthracene	L/4.0	L/1.5
Benzo(ghi)perylene	L/4.0	L/1.5
*Aniline	L/4.0	L/1.5
*Benzoic Acid	L/4.0	L/1.5
*Benzyl Alcohol	L/4.0	L/1.5
*4-Chloroaniline	L/4.0	L/1.5
*Dibenzofuran	4.4	L/1.5
*2-Methylnaphthalene	190.	L/1.5
*2-Methylphenol	L/4.0	L/1.5
*4-Methylphenol	L/4.0	L/1.5
*2-Nitroaniline	L/4.0	L/1.5
*3-Nitroaniline	L/4.0	L/1.5
*4-Nitroaniline	L/4.0	L/1.5
*2,4,5-Trichlorophenol	L/4.0	L/1.5



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PAGE NO. 8

Hart Crowser

LABORATORY NO. 97424

parts per million (mg/kg), dry basis

<u>Pesticides (by GC/ECD)</u>	<u>A</u>	<u>Method Blank</u>
alpha-BHC	L/0.05	L/0.05
beta-BHC	L/0.05	L/0.05
delta-BHC	L/0.05	L/0.05
gamma-BHC (lindane)	L/0.05	L/0.05
heptachlor	L/0.05	L/0.05
aldrin	L/0.05	L/0.05
heptachlor epoxide	L/0.05	L/0.05
dieldrin	L/0.05	L/0.05
4,4'-DDE	L/0.05	L/0.05
4,4'-DDD	L/0.1	L/0.1
endosulfan sulfate	L/0.1	L/0.1
4,4'-DDT	L/0.1	L/0.1
chlordan	L/0.1	L/0.1
alpha endosulfan	L/0.1	L/0.1
beta endosulfan	L/0.1	L/0.1
endrin	L/0.1	L/0.1
endrin aldehyde	L/0.1	L/0.1
toxaphene	L/5.	L/5.
PCB 1016	L/1.	L/1.
PCB 1221	L/1.	L/1.
PCB 1232	L/1.	L/1.
PCB 1242	L/1.	L/1.
PCB 1248	L/1.	L/1.
PCB 1254	10.7	L/1.
PCB 1260	4.6	L/1.
Methoxychlor	L/0.1	L/0.1
Endrin Ketone	L/0.1	L/0.1



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Key

L/ indicates "less than"

* indicates additional compounds from the EPA's Hazardous Substances List.

trace = an unquantifiable number between 2,500 and 12,500 (ug/kg) dry basis.

Respectfully submitted,

Laucks Testing Laboratories, Inc.

J. M. Owens
J. M. Owens

JMO:1aj



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APPENDIX

Surrogate Recovery Quality Control Report

Listed below are surrogate (chemically similar) compounds utilized in the analysis of volatile and organic compounds. The surrogates are added to every sample prior extraction and analysis to monitor for matrix effects, purging efficiency, and sample processing errors. The control limits represent the 95% confidence interval established in our laboratory through repetitive analysis of these sample types.

<u>parts per billion (ug/kg)</u>					
<u>Sample No.</u>	<u>Surrogate Compound</u>	<u>Spike Level</u>	<u>Spike Found</u>	<u>% Recovery</u>	<u>Control Limit</u>
MB	d4-1,2-Dichloroethane	50.	52.2	104.	50-160
MB	d8-Toluene	50.	49.1	98.2	50-160
MB	p-Bromofluorobenzene	50.	49.3	98.6	50-160
A	d4-1,2-Dichloroethane	127,000.	115,000.	90.6	50-160
A	d8-Toluene	127,000.	122,000.	96.1	50-160
A	p-Bromofluorobenzene	127,000.	128,000.	101.	50-160
Blank	Isodrin	0.050	0.034	69.	43-118*
A	Isodrin	0.050	0.050	99.	43-118*
Blank	Dibutylchloredate	0.100	0.074	74.	20-154
A	Dibutylchloredate	0.100	0.067	67.	20-154

*Control limits listed are for a water matrix. Soil matrix limits not yet determined.



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Sample Type: Soil
 Lab No: 97424
 Client: Hart Crowser
 QC Logged: 7/30/86

Surrogate Recovery Quality Control Report

Listed below are surrogate (chemically similar) compounds utilized in the analysis of organic compounds. The surrogates are added to every sample prior to extraction to monitor for matrix effects and sample processing errors. The control limits represent the 95% confidence interval established in our laboratory through repetitive analysis of these sample types. In certain cases, we will have accumulated insufficient data to have established control limits.

=====

Sample Number: Blank Reported Values in Units of: mg/kg

Surrogate Compound	Spike Level	Spike Detected	Percent Recovery	Control Limits
2-Fluorophenol	480	180	38	24-133
d5-Phenol	480	260	54	20-122
2-Bromophenol	480	230	48	---
d5-Nitrobenzene	240	86	36	20-140
2-Fluorobiphenyl	240	75	31	20-140
d10-Azobenzene	240	86	36	---
2,4,6-Tribromophenol	480	250	52	10-114
d14-p-Terphenyl	240	70	29	20-150

=====

=====

Sample Number: A Reported Values in Units of: mg/kg

Surrogate Compound	Spike Level	Spike Detected	Percent Recovery	Control Limits
2-Fluorophenol	480	220	46	24-133
d5-Phenol	480	280	58	20-122
2-Bromophenol	480	260	54	---
d5-Nitrobenzene	240	100	42	20-140
2-Fluorobiphenyl	240	98	41	20-140
d10-Azobenzene	240	140	58	---
2,4,6-Tribromophenol	480	160	33	10-114
d14-p-Terphenyl	240	100	42	20-150

=====

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CLIENT: Hart Crowser
1910 Fairview Avenue East
Seattle, WA 98102
ATTN: Phillip Spadaro

LABORATORY NFO: 97586

DATE: August 11, 1986

PO# 1264-06

REPORT ON: SOIL

SAMPLE

IDENTIFICATION: Submitted 7/7/86 and identified as shown below:

1)	S-1	PB-2	7/2/86	1415
2)	S-2	DM-2	7/2/86	1515
3)	S-3	PB-2	7/2/86	1845
4)	S-4	PB-2	7/2/86	1640
5)	S-1	PB-1	7/3/86	0905
6)	S-2	PB-1	7/3/86	0920
7)	S-3	PB-1	7/3/86	0940
8)	S-4	PB-1	7/3/86	1000
9)	S-5	PB-1	7/3/86	1045
10)	S-6	PB-1	7/3/86	1115

At your request only samples # 1, 3, 4, 7, 9, 10 were analyzed. Other samples were put on hold.

TESTS PERFORMED AND RESULTS:

Samples were analyzed for priority pollutants in accordance with Test Methods for Evaluating Solid Waste, (SW-846), U.S.E.P.A., 1982, Methods 8240 (volatile organics), 8270 (semi-volatile extractables), 8080 (pesticides and PCB's), 9010 (cyanide), 6010 and the 7000 series (metals analysis). Phenol analysis was in accordance with Method 420.2, Methods for Chemical Analysis of Water & Wastes, U.S.E.P.A., March, 1979.

Inorganics

	<u>1</u>	<u>3</u>	<u>4</u>	<u>7</u>
Total Solids, %	75.2	88.4	90.2	86.0



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Hart Crowser

LABORATORY NO: 97586

parts per million (mg/kg) dry basis

	<u>1</u>	<u>3</u>	<u>4</u>	<u>7</u>
Antimony	L/3.	L/3.	L/3.	L/3.
Arsenic	2.3	2.4	5.3	1.4
Beryllium	0.6	0.4	0.4	0.4
Cadmium	1.5	1.6	1.3	38.
Chromium	6700.	820.	540.	7400.
Copper	120.	23.	47.	350.
Lead	12.	8.	7.	8.
Mercury	L/0.1	L/0.1	L/0.1	L/0.1
Nickel	48.	22.	23.	89.
Selenium	L/0.5	L/0.5	L/0.5	L/0.5
Silver	0.3	L/0.1	L/0.1	0.2
Thallium	L/0.5	L/0.5	L/0.5	L/0.5
Zinc	57.	50.	32.	170.
Total Cyanide	0.6	L/0.5	L/0.5	3.3
Total Phenol	L/0.5	L/0.5	L/0.5	23.
Barium	170.	63.	66.	51.

	<u>9</u>	<u>10</u>	<u>Lab Blank</u>
Total Solids, %	87.4	88.3	---

parts per million (mg/kg) dry basis

Antimony	L/3.	L/3.	L/3.
Arsenic	3.2	2.3	L/0.5
Beryllium	0.8	0.4	L/0.1
Cadmium	3.6	2.1	L/0.5
Chromium	1600.	1000.	L/1.
Copper	110.	68.	L/1.
Lead	23.	6.	L/1.



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Hart Crowser

LABORATORY NO: 97586

	<u>9</u>	<u>10</u>	<u>Lab Blank</u>
	<u>parts per million (mg/kg) dry basis</u>		
Mercury	L/0.1	L/0.1	L/0.1
Nickel	46.	29.	L/2.
Selenium	L/0.5	L/0.5	L/0.5
Silver	L/0.1	L/0.1	0.9#
Thallium	L/0.5	L/0.5	L/0.5
Zinc	75.	65.	L/1.
Total Cyanide	L/0.5	L/0.5	L/0.5
Total Phenol	0.8	L/0.5	L/0.5
Barium	110.	71.	L/1.

Samples were analyzed for E.P. Toxicity in accordance with Test Methods for Evaluating Solid Wastes, (SW 846), U.S.E.P.A., July, 1982. Extraction was performed using Method 1310. Metals were analyzed by ICAP (Method 6010) and the 7000 series.

	<u>parts per million (mg/L)</u>			
	<u>1</u>	<u>3</u>	<u>4</u>	<u>7</u>
Antimony	L/0.2	L/0.2	L/0.2	L/0.2
Arsenic	L/0.2	L/0.2	L/0.2	L/0.2
Beryllium	L/0.01	L/0.01	L/0.01	L/0.01
Cadmium	L/0.01	L/0.01	L/0.01	0.01
Chromium	2.3	L/0.1	L/0.1	0.4
Copper	L/0.1	L/0.1	L/0.1	L/0.1
Lead	L/0.1	L/0.1	L/0.1	L/0.1
Mercury	L/0.005	L/0.005	L/0.005	L/0.005
Nickel	L/0.1	L/0.1	L/0.1	L/0.1
Selenium	L/0.2	L/0.2	L/0.2	L/0.2
Silver	L/0.1	L/0.1	L/0.1	L/0.1
Thallium	L/2.	L/2.	L/2.	L/2.
Zinc	L/0.1	L/0.1	L/0.1	0.1
Barium	L/0.1	L/0.1	0.1	0.1



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Hart Crowser

LABORATORY NO: 97586

parts per million (mg/L)

	<u>9</u>	<u>10</u>	<u>Lab Blank</u>
Antimony	L/0.2	L/0.2	L/0.2
Arsenic	L/0.2	L/0.2	L/0.2
Beryllium	L/0.01	L/0.01	L/0.01
Cadmium	L/0.01	L/0.01	L/0.01
Chromium	L/0.1	L/0.1	L/0.1
Copper	L/0.1	L/0.1	L/0.1
Lead	L/0.1	L/0.1	L/0.1
Mercury	L/0.005	L/0.005	L/0.005
Nickel	L/0.1	L/0.1	L/0.1
Selenium	L/0.2	L/0.2	L/0.2
Silver	L/0.1	L/0.1	L/0.1
Thallium	L/2.	L/2.	L/2.
Zinc	L/0.1	0.1	L/0.1
Barium	0.1	0.1	L/0.1

Volatile Organics (by GC/MS)

parts per billion (ug/kg) dry basis

	<u>1</u>	<u>3</u>	<u>4</u>	<u>7</u>
Chloromethane	L/500.	L/5.	L/5.	L/500.
Bromomethane	L/500.	L/5.	L/5.	L/500.
Vinyl Chloride	L/500.	L/5.	L/5.	L/500.
Chloroethane	L/500.	L/5.	L/5.	L/500.
Methylene Chloride	2900.	49.	70.	4600.
Acrolein	L/2500.	L/25.	L/25.	L/2500.
*Acetone	tracel	440.	590.	tracel
Acrylonitrile	L/2500.	L/25.	L/25.	L/2500.



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LABORATORY NO: 97586

Hart Crowser

parts per billion (ug/kg) dry basis

	<u>1</u>	<u>3</u>	<u>4</u>	<u>7</u>
*Carbon Disulfide	L/500.	L/5.	L/5.	L/500.
1,1-Dichloroethylene	L/500.	L/5.	L/5.	L/500.
1,1-Dichloroethane	L/500.	L/5.	L/5.	L/500.
trans-1,2-Dichloroethylene	L/500.	L/5.	L/5.	tracel
Chloroform	L/500.	L/5.	L/5.	L/500.
*2-Butanone	8700.	L/5.	L/5.	L/500.
1,2-Dichloroethane	L/500.	L/5.	L/5.	L/500.
1,1,1-Trichloroethane	L/500.	L/5.	L/5.	L/500.
*Vinyl Acetate	L/500.	L/5.	L/5.	L/500.
Bromodichloromethane	L/500.	L/5.	L/5.	L/500.
Carbon Tetrachloride	L/500.	L/5.	L/5.	L/500.
1,2-Dichloropropane	L/500.	L/5.	L/5.	L/500.
Trichloroethylene	L/500.	L/5.	L/5.	18,000.
Benzene	L/500.	L/5.	L/5.	L/500.
Chlorodibromomethane	L/500.	L/5.	L/5.	L/500.
1,1,2-Trichloroethane	L/500.	L/5.	L/5.	L/500.
2-Chloroethyl vinyl ether	L/500.	L/5.	L/5.	L/500.
Bromoform	L/500.	L/5.	L/5.	L/500.
*4-Methyl-2-pentanone	L/500.	L/5.	L/5.	L/500.
*2-Hexanone	L/500.	L/5.	L/5.	L/500.
1,1,2,2-Tetrachloroethane	L/500.	L/5.	L/5.	L/500.
Tetrachloroethylene	L/500.	L/5.	L/5.	L/500.
Toluene	tracel	L/5.	L/5.	3600.
Chlorobenzene	L/500.	L/5.	L/5.	L/500.
trans-1,3-Dichloropropene	L/500.	L/5.	L/5.	L/500.
Ethylbenzene	L/500.	L/5.	L/5.	L/500.
cis-1,3-Dichloropropene	L/500.	L/5.	L/5.	L/500.
*Styrene	L/500.	L/5.	L/5.	L/500.
*Total Xylenes	tracel	L/5.	L/5.	tracel



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Hart Crowser

LABORATORY NO: 97586

parts per billion (ug/kg) dry basis

	<u>9</u>	<u>10</u>	<u>Lab 1</u> <u>Blank</u>	<u>Lab 2</u> <u>Blank</u>
Chloromethane	L/500.	L/500.	L/5.	L/5.
Bromomethane	L/500.	L/500.	L/5.	L/5.
Vinyl Chloride	L/500.	L/500.	L/5.	L/5.
Chloroethane	L/500.	L/500.	L/5.	L/5.
Methylene Chloride	tracel	tracel	trace2	L/5.
Acrolein	L/2500.	L/2500.	L/25.	L/25.
*Acetone	2800.	2700.	trace2	L/5.
Acrylonitrile	L/2500.	L/2500.	L/25.	L/25.
*Carbon Disulfide	L/500.	L/500.	L/5.	L/5.
1,1-Dichloroethylene	L/500.	L/500.	L/5.	L/5.
1,1-Dichloroethane	L/500.	L/500.	L/5.	L/5.
trans-1,2-Dichloroethylene	L/500.	L/500.	L/5.	L/5.
Chloroform	L/500.	L/500.	L/5.	L/5.
*2-Butanone	5700.	6100.	57.	L/5.
1,2-Dichloroethane	L/500.	L/500.	L/5.	L/5.
1,1,1-Trichloroethane	L/500.	L/500.	L/5.	L/5.
*Vinyl Acetate	L/500.	L/500.	L/5.	L/5.
Bromodichloromethane	L/500.	L/500.	L/5.	L/5.
Carbon Tetrachloride	L/500.	L/500.	L/5.	L/5.
1,2-Dichloropropane	L/500.	L/500.	L/5.	L/5.
Trichloroethylene	L/500.	L/500.	L/5.	L/5.
Benzene	L/500.	L/500.	L/5.	L/5.
Chlorodibromomethane	L/500.	L/500.	L/5.	L/5.
1,1,2-Trichloroethane	L/500.	L/500.	L/5.	L/5.
2-Chloroethyl vinyl ether	L/500.	L/500.	L/5.	L/5.
Bromoform	L/500.	L/500.	L/5.	L/5.
*4-Methyl-2-pentanone	L/500.	L/500.	L/5.	L/5.
*2-Hexanone	L/500.	L/500.	L/5.	L/5.
1,1,2,2-Tetrachloroethane	L/500.	L/500.	L/5.	L/5.
Tetrachloroethylene	L/500.	L/500.	L/5.	L/5.



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LABORATORY NO: 97586

parts per billion (ug/kg) dry basis

	<u>9</u>	<u>10</u>	<u>Lab 1</u> <u>Blank</u>	<u>Lab 2</u> <u>Blank</u>
Toluene	L/500.	L/500.	L/5.	L/5.
Chlorobenzene	L/500.	L/500.	L/5.	L/5.
trans-1,3-Dichloropropene	L/500.	L/500.	L/5.	L/5.
Ethylbenzene	L/500.	tracel	L/5.	L/5.
cis-1,3-Dichloropropene	L/500.	L/500.	L/5.	L/5.
*Styrene	L/500.	L/500.	L/5.	L/5.
*Total Xylenes	tracel	7900.	L/5.	L/5.

Extractables (by GC/MS)

parts per billion (ug/kg) dry basis

	<u>1</u>	<u>3</u>	<u>4</u>	<u>7</u>
N-nitrosodimethylamine	L/50.	L/50.	L/50.	L/1900.
Bis(2-chloroethyl) ether	L/50.	L/50.	L/50.	L/1900.
2-Chlorophenol	L/50.	L/50.	L/50.	L/1900.
Phenol	190.	L/50.	L/50.	8900.
1,3-Dichlorobenzene	L/50.	L/50.	L/50.	L/1900.
1,4-Dichlorobenzene	L/50.	L/50.	L/50.	L/1900.
1,2-Dichlorobenzene	L/50.	L/50.	L/50.	L/1900.
Bis(2-chloroisopropyl) ether	L/50.	L/50.	L/50.	L/1900.
Hexachloroethane	L/50.	L/50.	L/50.	L/1900.
N-nitroso-di-n-propylamine	L/50.	L/50.	L/50.	L/1900.
Nitrobenzene	L/50.	L/50.	L/50.	L/1900.
Isophorone	L/50.	L/50.	L/50.	L/1900.
2-Nitrophenol	L/50.	L/50.	L/50.	L/1900.
2,4-Dimethylphenol	L/50.	L/50.	L/50.	L/1900.
Bis(2-chloroethoxy) methane	L/50.	L/50.	L/50.	L/1900.



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parts per billion (ug/kg) dry basis

	<u>1</u>	<u>3</u>	<u>4</u>	<u>7</u>
2,4-Dichlorophenol	L/50.	L/50.	L/50.	L/1900.
1,2,4-Trichlorobenzene	L/50.	L/50.	L/50.	L/1900.
Naphthalene	440.	L/50.	L/50.	6500.
Hexachlorobutadiene	L/50.	L/50.	L/50.	L/1900.
4-Chloro-m-cresol	L/50.	L/50.	L/50.	L/1900.
Hexachlorocyclopentadiene	L/50.	L/50.	L/50.	L/1900.
2,4,6-Trichlorophenol	L/50.	L/50.	L/50.	L/1900.
2-Chloronaphthalene	L/50.	L/50.	L/50.	L/1900.
Acenaphthylene	L/50.	L/50.	L/50.	L/1900.
Dimethylphthalate	L/50.	L/50.	L/50.	L/1900.
2,6-Dinitrotoluene	L/50.	L/50.	L/50.	L/1900.
Acenaphthene	L/50.	L/50.	L/50.	3700.
2,4-Dinitrophenol	L/50.	L/50.	L/50.	L/1900.
2,4-Dinitrotoluene	L/50.	L/50.	L/50.	L/1900.
4-Nitrophenol	L/50.	L/50.	L/50.	L/1900.
Fluorene	52.	L/50.	L/50.	2800.
4-Chlorophenyl phenyl ether	L/50.	L/50.	L/50.	L/1900.
Diethylphthalate	L/50.	L/50.	L/50.	L/1900.
4,6-Dinitro-o-cresol	L/50.	L/50.	L/50.	L/1900.
1,2-Diphenylhydrazine	L/50.	L/50.	L/50.	L/1900.
4-Bromophenyl phenyl ether	L/50.	L/50.	L/50.	L/1900.
Hexachlorobenzene	L/50.	L/50.	L/50.	L/1900.
Pentachlorophenol	L/50.	L/50.	L/50.	L/1900.
Phenanthrene	800.	L/50.	L/50.	12,000.
Anthracene	L/50.	L/50.	L/50.	2800.
Dibutylphthalate	77.	L/50.	250.	L/1900.
Fluoranthene	L/50.	L/50.	L/50.	L/1900.
Pyrene	L/50.	L/50.	L/50.	2900.
Benzidine	L/50.	L/50.	L/50.	L/1900.
Butyl benzyl phthalate	L/50.	L/50.	L/50.	L/1900.
Benzo (a) anthracene	L/50.	L/50.	L/50.	1900.
Chrysene	70.	L/50.	L/50.	L/1900.



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	<u>1</u>	<u>3</u>	<u>4</u>	<u>7</u>
3,3'-Dichlorobenzidine	L/50.	L/50.	L/50.	L/1900.
Bis (2-ethylhexyl) phthalate	160.	170.	5400.	L/1900.
N-nitrosodiphenylamine	L/50.	L/50.	L/50.	L/1900.
Di-n-octyl phthalate	L/50.	L/50.	L/50.	L/1900.
Benzo (b) fluoranthene	L/50.	L/50.	L/50.	L/1900.
Benzo (k) fluoranthene	L/50.	L/50.	L/50.	L/1900.
Benzo (a) pyrene	L/50.	L/50.	L/50.	L/1900.
Indeno (1,2,3-cd) pyrene	L/50.	L/50.	L/50.	L/1900.
Dibenzo (ah) anthracene	L/50.	L/50.	L/50.	L/1900.
Benzo (ghi) perylene	L/50.	L/50.	L/50.	L/1900.
*Aniline	L/50.	L/50.	L/50.	L/1900.
*Benzoic Acid	L/50.	L/50.	L/50.	L/1900.
*Benzyl Alcohol	L/50.	L/50.	L/50.	L/1900.
*4-Chloroaniline	L/50.	L/50.	L/50.	L/1900.
*Dibenzofuran	82.	L/50.	L/50.	L/1900.
*2-Methylnaphthalene	3300.	L/50.	L/50.	51,000.
*2-Methylphenol	L/50.	L/50.	L/50.	L/1900.
*4-Methylphenol	L/50.	L/50.	L/50.	2100.
*2-Nitroaniline	L/50.	L/50.	L/50.	L/1900.
*3-Nitroaniline	L/50.	L/50.	L/50.	L/1900.
*4-Nitroaniline	L/50.	L/50.	L/50.	L/1900.
*2,4,5-Trichlorophenol	L/50.	L/50.	L/50.	L/1900.

	<u>9</u>	<u>10</u>	<u>Lab Blank</u>
N-nitrosodimethylamine	L/180.	L/110.	L/50.
Bis (2-chloroethyl) ether	L/180.	L/110.	L/50.
2-Chlorophenol	L/180.	L/110.	L/50.
Phenol	L/180.	L/110.	L/50.
1,3-Dichlorobenzene	L/180.	L/110.	L/50.
1,4-Dichlorobenzene	L/180.	L/110.	L/50.



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	<u>9</u>	<u>10</u>	<u>Lab Blank</u>
1,2-Dichlorobenzene	L/180.	L/110.	L/50.
Bis(2-chloroisopropyl) ether	L/180.	L/110.	L/50.
Hexachloroethane	L/180.	L/110.	L/50.
N-nitroso-di-n-propylamine	L/180.	L/110.	L/50.
Nitrobenzene	L/180.	L/110.	L/50.
Isophorone	L/180.	L/110.	L/50.
2-Nitrophenol	L/180.	L/110.	L/50.
2,4-Dimethylphenol	L/180.	L/110.	L/50.
Bis(2-chloroethoxy) methane	L/180.	L/110.	L/50.
2,4-Dichlorophenol	L/180.	L/110.	L/50.
1,2,4-Trichlorobenzene	L/180.	L/110.	L/50.
Naphthalene	1900.	2200.	L/50.
Hexachlorobutadiene	L/180.	L/110.	L/50.
4-Chloro-m-cresol	L/180.	L/110.	L/50.
Hexachlorocyclopentadiene	L/180.	L/110.	L/50.
2,4,6-Trichlorophenol	L/180.	L/110.	L/50.
2-Chloronaphthalene	L/180.	L/110.	L/50.
Acenaphthylene	L/180.	L/110.	L/50.
Dimethylphthalate	L/180.	L/110.	L/50.
2,6-Dinitrotoluene	L/180.	L/110.	L/50.
Acenaphthene	900.	530.	L/50.
2,4-Dinitrophenol	L/180.	L/110.	L/50.
2,4-Dinitrotoluene	L/180.	L/110.	L/50.
4-Nitrophenol	L/180.	L/110.	L/50.
Fluorene	1200.	850.	L/50.
4-Chlorophenyl phenyl ether	L/180.	L/110.	L/50.
Diethylphthalate	L/180.	L/110.	L/50.
4,6-Dinitro-o-cresol	L/180.	L/110.	L/50.
1,2-Diphenylhydrazine	L/180.	L/110.	L/50.
4-Bromophenyl phenyl ether	L/180.	L/110.	L/50.
Hexachlorobenzene	L/180.	L/110.	L/50.
Pentachlorophenol	L/180.	L/110.	L/50.



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parts per billion (ug/kg) dry basis

	<u>9</u>	<u>10</u>	<u>Lab Blank</u>
Phenanthrene	4200.	2200.	L/50.
Anthracene	910.	450.	L/50.
Dibutylphthalate	590.	860.	L/50.
Fluoranthene	240.	L/110.	L/50.
Pyrene	460.	L/110.	L/50.
Benzidine	L/180.	L/110.	L/50.
Butyl benzyl phthalate	L/180.	L/110.	L/50.
Benzo (a) anthracene	370.	L/110.	L/50.
Chrysene	570.	L/110.	L/50.
3,3'-Dichlorobenzidine	L/180.	L/110.	L/50.
Bis (2-ethylhexyl) phthalate	7200.	760.	L/50.
N-nitrosodiphenylamine	L/180.	L/110.	L/50.
Di-n-octyl phthalate	690.	140.	L/50.
Benzo (b) fluoranthene	L/180.	L/110.	L/50.
Benzo (k) fluoranthene	L/180.	L/110.	L/50.
Benzo (a) pyrene	300.	L/110.	L/50.
Indeno (1,2,3-cd) pyrene	L/180.	L/110.	L/50.
Dibenzo (ah) anthracene	L/180.	L/110.	L/50.
Benzo (ghi) perylene	L/180.	L/110.	L/50.
*Aniline	L/180.	L/110.	L/50.
*Benzoic Acid	L/180.	L/110.	L/50.
*Benzyl Alcohol	L/180.	L/110.	L/50.
*4-Chloroaniline	L/180.	L/110.	L/50.
*Dibenzofuran	280.	160.	L/50.
*2-Methylnaphthalene	14,000.	7800.	L/50.
*2-Methylphenol	L/180.	L/110.	L/50.
*4-Methylphenol	L/180.	L/110.	L/50.
*2-Nitroaniline	L/180.	L/110.	L/50.
*3-Nitroaniline	L/180.	L/110.	L/50.
*4-Nitroaniline	L/180.	L/110.	L/50.
*2,4,5-Trichlorophenol	L/180.	L/110.	L/50.



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Pesticides (by GC/ECD)

parts per billion (ug/kg) dry basis

	<u>1</u>	<u>. 3</u>	<u>4</u>	<u>7</u>
alpha-BHC	L/2.	L/2.	L/2.	L/2.
beta-BHC	L/2.	L/2.	L/2.	L/2.
delta-BHC	L/2.	L/2.	L/2.	L/2.
gamma-BHC (lindane)	L/2.	L/2.	L/2.	L/2.
heptachlor	L/2.	L/2.	L/2.	L/2.
aldrin	L/2.	L/2.	L/2.	L/2.
heptachlor epoxide	L/2.	L/2.	L/2.	L/2.
dieldrin	L/2.	L/2.	L/2.	L/2.
4,4'-DDE	L/2.	L/2.	L/2.	L/2.
4,4'-DDD	L/4.	L/4.	L/4.	L/4.
endosulfan sulfate	L/4.	L/4.	L/4.	L/4.
4,4'-DDT	L/4.	L/4.	L/4.	L/4.
chlordane	L/4.	L/4.	L/4.	L/4.
alpha endosulfan	L/4.	L/4.	L/4.	L/4.
beta endosulfan	L/4.	L/4.	L/4.	L/4.
endrin	L/4.	L/4.	L/4.	L/4.
endrin aldehyde	L/4.	L/4.	L/4.	L/4.
toxaphene	L/100.	L/100.	L/100.	L/100.
PCB 1016	L/80.	L/80.	L/80.	L/80.
PCB 1221	L/80.	L/80.	L/80.	L/80.
PCB 1232	L/80.	L/80.	L/80.	L/80.
PCB 1242	L/80.	L/80.	L/80.	3900.
PCB 1248	L/80.	L/80.	L/80.	L/80.
PCB 1254	1100.	L/80.	L/80.	L/80.
PCB 1260	L/80.	L/80.	L/80.	L/80.
Methoxychlor	L/8.	L/8.	L/8.	L/8.
Endrin Ketone	L/4.	L/4.	L/4.	L/4.



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parts per billion (ug/kg) dry basis

	<u>9</u>	<u>10</u>	<u>Lab Blank</u>
alpha-BHC	L/2.	L/2.	L/2.
beta-BHC	L/2.	L/2.	L/2.
delta-BHC	L/2.	L/2.	L/2.
gamma-BHC (lindane)	L/2.	L/2.	L/2.
heptachlor	L/2.	L/2.	L/2.
aldrin	L/2.	L/2.	L/2.
heptachlor epoxide	L/2.	L/2.	L/2.
dieldrin	L/2.	L/2.	L/2.
4,4'-DDE	L/2.	L/2.	L/2.
4,4'-DDD	L/4.	L/4.	L/4.
endosulfan sulfate	L/4.	L/4.	L/4.
4,4'-DDT	L/4.	L/4.	L/4.
chlordane	L/4.	L/4.	L/4.
alpha endosulfan	L/4.	L/4.	L/4.
beta endosulfan	L/4.	L/4.	L/4.
endrin	L/4.	L/4.	L/4.
endrin aldehyde	L/4.	L/4.	L/4.
toxaphene	L/100.	L/100.	L/100.
PCB 1016	L/80.	L/80.	L/80.
PCB 1221	L/80.	L/80.	L/80.
PCB 1232	L/80.	L/80.	L/80.
PCB 1242	L/80.	L/80.	L/80.
PCB 1248	L/80.	L/80.	L/80.
PCB 1254	1500.	850.	L/80.
PCB 1260	L/80.	L/80.	L/80.
Methoxychlor	L/8.	L/8.	L/8.
Endrin Ketone	L/4.	L/4.	L/4.



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Comment:

Methylene Chloride and Acetone are common solvents in everyday use in the laboratory. Presence of these compounds, at least to the level found in the blank, is most likely due to unavoidable laboratory contamination.

Key

L/ indicates "less than"

* indicates additional compounds from the EPA's Hazardous Substances List.

tracel indicates an unquantifiable amount between 500-2500 parts per billion.

trace2 indicates an unquantifiable amount between 5-25 parts per billion.

indicates a second blank was run with this set and its value was 0.2.

Respectfully submitted,

Laucks Testing Laboratories, Inc.

J. M. Owens

JMO:dr



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APPENDIX A

Matrix Spike/Matrix Spike Duplicate Report

		<u>parts per billion (ug/kg)*</u>				<u>ug/kg*</u>		
<u>Sample</u>	<u>Analyte</u>	<u>Spike Added</u>	<u>Sample Result</u>	<u>MS Result</u>	<u>% Rec</u>	<u>MSD Result</u>	<u>% Rec</u>	<u>RPD</u>
<u>Pesticides</u>								
4	Lindane	30.6	L/2.	18.5	60.4	23.5	76.9	24.0
4	Heptachlor	30.6	L/2.	16.1	52.6	20.3	66.4	23.2
4	Aldrin	30.6	L/2.	16.6	54.3	20.2	66.1	19.6
4	Dieldrin	76.6	L/2.	55.6	71.6	66.7	87.0	19.4
4	Endrin	76.6	L/4.	56.1	73.2	66.9	87.3	25.4
4	DDT	76.6	L/4.	63.6	83.0	98.6	129.	43.4

		<u>parts per million (mg/kg) *</u>				<u>mg/kg*</u>		
<u>Inorganic Metals</u>								
4	Mercury	0.5	L/0.1	0.5	102.	0.5	106.	4.
10	Phenol	1.6	L/0.5	1.5	94.	1.5	94.	0.
3	Selenium	2.5	L/0.5	2.8	112.	2.9	116.	-4.
3	Arsenic	25.0	2.4	23.5	84.	24.7	89.	-6.
3	Cyanide	3.6	L/0.5	2.4	67.	2.5	69.	3.
3	Chromium	25.	820.	**	**	**	**	**
3	Copper	50.	23.	73.	100.	72.	98.	2.0
3	Lead	50.	8.	43.	70.	47.	78.	11.
3	Nickel	25.	22.	50.	112.	47.	100.	1.1
3	Zinc	100.	50.	150.	100.	146.	96.	4.1
3	Barium	500.	63.	646.	117.	631.	114.	2.6
3	Silver	10.	L/0.1	7.3	73.	6.8	68.	7.1
3	Thallium	2.5	L/0.5	2.1	84.	1.8	72.	15.



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<u>Sample</u>	<u>Analyte</u>	<u>Spike Added</u>	<u>Sample Result</u>	<u>MS Result</u>	<u>% Rec</u>	<u>MSD Result</u>	<u>% Rec</u>	<u>RPD</u>
		<u>parts per million (mg/L)</u>				<u>mg/L</u>		
<u>EP Tox Extract</u>								
10	Mercury	0.025	L/0.005	0.027	108.	0.027	108.	0.
4	Silver	1.00	L/0.1	0.73	73.	0.70	70.	4.2
4	Arsenic	1.00	L/0.2	0.79	79.	0.80	80.	1.2
4	Barium	1.00	0.1	1.02	92.	1.02	92.	0.
4	Cadmium	1.00	L/0.01	0.92	92.	0.90	90.	2.2
4	Chromium	1.00	L/0.1	0.92	92.	0.92	92.	0.
4	Lead	1.00	L/0.1	0.90	90.	0.84	84.	6.9
4	Selenium	1.00	L/0.2	0.99	99.	0.93	93.	6.2
4	Nickel	1.00	L/0.1	0.93	93.	0.94	94.	1.1
4	Antimony	1.00	L/0.2	0.90	90.	0.82	82.	9.3
4	Beryllium	1.00	L/0.01	0.90	90.	0.89	89.	1.1.
4	Copper	1.00	L/0.1	0.74	74.	0.92	92.	22.
4	Thallium	5.0	L/2.	4.2	84.	4.1	82.	2.4
4	Zinc	1.00	L/0.1	0.99	99.	1.00	100.	1.0

* reported on the dry basis

** Samples are spiked prior to preparation and analysis at a level deemed to be generally appropriate to the average sample processed in the laboratory. In this case, the level of analyte already present in the sample was large enough to make an accurate determination of spike recovery impossible.

MS = Matrix Spike
MSD = Matrix Spike Duplicate

Rec = Recovery
RPD = Relative Percent Difference



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APPENDIX B

Surrogate Recovery Quality Control Report

Listed below are surrogate (chemically similar) compounds utilized in the analysis of volatile and organic compounds. The surrogates are added to every sample prior to extraction and analysis to monitor for matrix effects, purging efficiency, and sample processing errors. The control limits represent the 95% confidence interval established in our laboratory through repetitive analysis of these sample types.

<u>Sample No.</u>	<u>Surrogate Compound</u>	<u>Spike Level</u>	<u>Spike Found</u>	<u>% Recovery</u>	<u>Control Limit</u>
<u>parts per billion (ug/kg) #</u>					
<u>Volatiles</u>					
Lab Blank 1	d4-1,2-Dichloroethane	50.	52.8	106.	50-160
	d8-Toluene	50.	50.9	102.	50-160
	p-Bromofluorobenzene	50.	49.9	99.8	50-160
1	d4-1,2-Dichloroethane	6650.	7410.	111.	50-160
	d8-Toluene	6650.	6700.	101.	50-160
	p-Bromofluorobenzene	6650.	7310.	110.	50-160
1 MS	d4-1,2-Dichloroethane	6650.	7410.	111.	50-160
	d8-Toluene	6650.	6680.	100.	50-160
	p-Bromofluorobenzene	6650.	7490.	113.	50-160
1 MSD	d4-1,2-Dichloroethane	6650.	7550.	115.	50-160
	d8-Toluene	6650.	6600.	99.3	50-160
	p-Bromofluorobenzene	6650.	7210.	108.	50-160



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Hart Crowser

LABORATORY NO: 97586

<u>Sample No.</u>	<u>Surrogate Compound</u>	<u>Spike Level</u>	<u>Spike Found</u>	<u>% Recovery</u>	<u>Control Limit</u>
<u>parts per billion (ug/kg) #</u>					
7	d4-1,2-Dichloroethane	23,200.	19,700.	84.9	50-160
	d8-Toluene	23,200.	23,000.	99.1	50-160
	p-Bromofluorobenzene	23,200.	27,300.	118.	50-160
9	d4-1,2-Dichloroethane	22,400.	23,900.	107.	50-160
	d8-Toluene	22,400.	21,500.	96.0	50-160
	p-Bromofluorobenzene	22,400.	25,700.	115.	50-160
10	d4-1,2-Dichloroethane	23,300.	24,900.	107.	50-160
	d8-Toluene	23,300.	22,700.	97.4	50-160
	p-Bromofluorobenzene	23,300.	25,500.	109.	50-160
Lab Blank 2	d4-1,2-Dichloroethane	50.	46.5	93.0	50-160
	d8-Toluene	50.	49.6	99.2	50-160
	p-Bromofluorobenzene	50.	49.5	99.0	50-160
3	d4-1,2-Dichloroethane	148.	140.	94.6	50-160
	d8-Toluene	148.	147.	99.3	50-160
	p-Bromofluorobenzene	148.	148.	100.	50-160
4	d4-1,2-Dichloroethane	137.	129.	94.2	50-160
	d8-Toluene	137.	138.	101.	50-160
	p-Bromofluorobenzene	137.	139.	101.	50-160



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Hart Crowser

LABORATORY NO: 97586

<u>Sample No.</u>	<u>Surrogate Compound</u>	<u>Spike Level</u>	<u>Spike Found</u>	<u>% Recovery</u>	<u>Control Limit</u>
<u>parts per billion (ug/kg) #</u>					
<u>Pesticides/PCBs</u>					
Lab Blank	Isodrin	40.0	23.0	57.4	43-118*
1	Isodrin	40.0	27.7	69.2	43-118*
3	Isodrin	40.0	24.7	61.8	43-118*
4	Isodrin	40.0	22.7	56.8	43-118*
7	Isodrin	40.0	88.8	222.**	43-118*
9	Isodrin	40.0	18.6	46.6	43-118*
10	Isodrin	40.0	24.7	61.8	43-118*
4 MS	Isodrin	40.0	21.0	52.4	43-118*
4 MSD	Isodrin	40.0	34.9	87.3	
Lab Blank	Dibutylchloredate	80.0	54.9	68.6	20-154
1	Dibutylchloredate	80.0	76.6	95.8	20-154
3	Dibutylchloredate	80.0	53.9	67.4	20-154
4	Dibutylchloredate	80.0	80.8	101.	20-154
7	Dibutylchloredate	80.0	138.	172.**	20-154
9	Dibutylchloredate	80.0	130.	163.**	20-154
10	Dibutylchloredate	80.0	71.0	88.8	20-154
4 MS	Dibutylchloredate	80.0	51.0	63.7	20-154
4 MSD	Dibutylchloredate	80.0	103.	129.**	20-154

* Control limits are established when a sufficient number of analyses have been performed for an analyte in a specific matrix to allow development of a statistically meaningful figure. In this case, no control limits have been established in the soil matrix and the limits given are for a water matrix and should be regarded as estimates.

** Matrix interference. Presence of unknown constituents in the sample (which were not on your list of analytes and therefore were not determined) will occasionally interfere with our ability to detect your target compounds at a more sensitive level, or will mask or enhance the measurement of spiking compound concentration.

reported on the dry basis



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Laucks Testing Laboratories, Inc.

Sample Type: Soil
 Lab No: 97586
 Client: Hart Crowser
 QC Logged: 8/5/86

Surrogate Recovery Quality Control Report

Listed below are surrogate (chemically similar) compounds utilized in the analysis of organic compounds. The surrogates are added to every sample prior to extraction to monitor for matrix effects and sample processing errors. The control limits represent the 95% confidence interval established in our laboratory through repetitive analysis of these sample types. In certain cases, we will have accumulated insufficient data to have established control limits.

=====				
Sample Number: Blank		Reported Values in Units of: ug/kg		

Surrogate Compound	Spike Level	Spike Detected	Percent Recovery	Control Limits
=====				
2-Fluorophenol	4000	2670	67	24-133
d5-Phenol	4000	3290	82	20-122
2-Bromophenol	4000	2790	70	---
d5-Nitrobenzene	2000	1250	63	20-140
2-Fluorobiphenyl	2000	1760	88	20-140
d10-Azobenzene	2000	1210	61	---
2,4,6-Tribromophenol	4000	4780	120	10-114 **
d14-p-Terphenyl	2000	1190	60	20-150

=====				
Sample Number: 1		Reported Values in Units of: ug/kg		

Surrogate Compound	Spike Level	Spike Detected	Percent Recovery	Control Limits
=====				
2-Fluorophenol	4590	2780	61	24-133
d5-Phenol	4590	3500	76	20-122
2-Bromophenol	4590	3750	82	---
d5-Nitrobenzene	2300	1290	56	20-140
2-Fluorobiphenyl	2300	2050	89	20-140
d10-Azobenzene	2300	1050	46	---
2,4,6-Tribromophenol	4590	4120	90	10-114
d14-p-Terphenyl	2300	1300	57	20-150

** outside QC limit - no action taken

Laucks Testing Laboratories, Inc.

Sample Type: Soil
Lab No: 97586
Client: Hart Crowser
QC Logged: 8/5/86

Surrogate Recovery Quality Control Report

=====				
Sample Number: 3		Reported Values in Units of: ug/kg		

Surrogate Compound	Spike Level	Spike Detected	Percent Recovery	Control Limits
=====				
2-Fluorophenol	3730	1310	35	24-133
d5-Phenol	3730	2240	60	20-122
2-Bromophenol	3730	1770	47	---
d5-Nitrobenzene	1870	1090	58	20-140
2-Fluorobiphenyl	1870	1190	64	20-140
d10-Azobenzene	1870	1110	59	---
2,4,6-Tribromophenol	3730	1640	44	10-114
d14-p-Terphenyl	1870	1100	59	20-150

=====				
Sample Number: 4		Reported Values in Units of: ug/kg		

Surrogate Compound	Spike Level	Spike Detected	Percent Recovery	Control Limits
=====				
2-Fluorophenol	3830	1600	42	24-133
d5-Phenol	3830	2430	63	20-122
2-Bromophenol	3830	2060	54	---
d5-Nitrobenzene	1920	1070	56	20-140
2-Fluorobiphenyl	1920	1410	73	20-140
d10-Azobenzene	1920	1200	63	---
2,4,6-Tribromophenol	3830	3160	83	10-114
d14-p-Terphenyl	1920	1060	55	20-150

=====				
Sample Number: 4 MS		Reported Values in Units of: ug/kg		

Surrogate Compound	Spike Level	Spike Detected	Percent Recovery	Control Limits
=====				
2-Fluorophenol	3830	2020	53	24-133
d5-Phenol	3830	3340	87	20-122
2-Bromophenol	3830	2870	75	---
d5-Nitrobenzene	1920	1310	68	20-140
2-Fluorobiphenyl	1920	1130	59	20-140
d10-Azobenzene	1920	1150	60	---
2,4,6-Tribromophenol	3830	2510	66	10-114
d14-p-Terphenyl	1920	740	39	20-150

Laucks Testing Laboratories, Inc.

Sample Type: Soil
Lab No: 97586
Client: Hart Crowser
QC Logged: 8/5/86

Surrogate Recovery Quality Control Report

Sample Number: 4 MSD Reported Values in Units of: ug/kg

Surrogate Compound	Spike Level	Spike Detected	Percent Recovery	Control Limits
2-Fluorophenol	3830	1750	46	24-133
d5-Phenol	3830	2990	78	20-122
2-Bromophenol	3830	2580	67	---
d5-Nitrobenzene	1920	1230	64	20-140
2-Fluorobiphenyl	1920	1190	62	20-140
d10-Azobenzene	1920	1120	58	---
2,4,6-Tribromophenol	3830	2020	53	10-114
d14-p-Terphenyl	1920	761	40	20-150

Sample Number: 7 Reported Values in Units of: ug/kg

Surrogate Compound	Spike Level	Spike Detected	Percent Recovery	Control Limits
2-Fluorophenol	3830	1610	42	24-133
d5-Phenol	3830	2680	70	20-122
2-Bromophenol	3830	2180	57	---
d5-Nitrobenzene	1920	712	37	20-140
2-Fluorobiphenyl	1920	1160	60	20-140
d10-Azobenzene	1920	1220	64	---
2,4,6-Tribromophenol	3830	1180	31	10-114
d14-p-Terphenyl	1920	852	44	20-150

Sample Number: 9 Reported Values in Units of: ug/kg

Surrogate Compound	Spike Level	Spike Detected	Percent Recovery	Control Limits
2-Fluorophenol	3920	2100	54	24-133
d5-Phenol	3920	2430	62	20-122
2-Bromophenol	3920	2350	60	---
d5-Nitrobenzene	1960	874	45	20-140
2-Fluorobiphenyl	1960	1140	58	20-140
d10-Azobenzene	1960	976	50	---
2,4,6-Tribromophenol	3920	1660	42	10-114
d14-p-Terphenyl	1960	702	36	20-150

Laucks Testing Laboratories, Inc.

Sample Type: Soil
Lab No: 97586
Client: Hart Crowser
QC Logged: 8/5/86

Surrogate Recovery Quality Control Report

=====				
Sample Number: 10		Reported Values in Units of: ug/kg		

Surrogate Compound	Spike Level	Spike Detected	Percent Recovery	Control Limits
=====				
2-Fluorophenol	3770	3180	84	24-133
d5-Phenol	3770	4090	108	20-122
2-Bromophenol	3770	3140	83	---
d5-Nitrobenzene	1890	1680	89	20-140
2-Fluorobiphenyl	1890	1700	90	20-140
d10-Azobenzene	1890	1400	74	---
2,4,6-Tribromophenol	3770	2350	62	10-114
d14-p-Terphenyl	1890	1080	57	20-150

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Hart Crowser

LABORATORY NO: 97586

APPENDIX C

Matrix Spike/Duplicate Spike Quality Control

Organics

Reported below are the results of additional QC compounds utilized in the analysis of organic compounds. Compounds of interest are spiked into two additional sample aliquots prior to extraction and/or analysis to monitor for matrix effects, sample processing errors, and to calculate percent recoveries of compounds of interest and relative error in the analysis. The control limits represent the 95% confidence interval established in the laboratory through repetitive analysis of these sample types.

Sample 1

<u>Compound</u>	<u>ug/kg#</u>			<u>ug/kg#</u>			<u>RPD</u>	<u>RPD Limit</u>	<u>REC Limit</u>
	<u>Conc Spike</u>	<u>Conc Samp</u>	<u>Conc MS</u>	<u>% REC</u>	<u>Conc MSD</u>	<u>% REC</u>			
<u>Volatiles</u>									
1,1-Dichloroethene	250.	0.	5598.	84.2	5386.	81.0	3.9	22	59-172
Trichloroethene	250.	93.1	6263.	94.2	6051.	91.0	3.5	24	62-137
Chlorobenzene	250.	0.	6317.	95.0	6197.	93.2	1.9	21	60-133
Toluene	250.	465.	6994.	105.	6755.	102.	2.9	21	59-139
Benzene	250.	0.	6516.	98.0	6223.	93.6	4.6	21	66-142

reported on the dry basis

Conc = Concentration
Samp = Sample
MS = Matrix Spike

MSD = Matrix Spike Duplicate
REC = Recovery
RPD = Relative Percent Difference



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Laucks Testing Laboratories, Inc.

Lab No: 97586
Client: Hart Crowser
QC Logged: 8/6/86

Soil
Matrix spike/Duplicate Spike
Quality Control Report

Reported below are the results of additional QC compounds utilized in the analysis of organic compounds. Compounds of interest are spiked into two additional sample aliquots prior to extraction and/or analysis to monitor for matrix effects, sample processing errors, and to calculate percent recoveries of compounds of interest and relative error in the analysis. The control limits represent the 95% confidence interval established in the laboratory through repetitive analysis of the samples

=====											
Sample Number: 4			Reported Values in Units of: ug/kg								

BASE/NEUTRALS			CONC SPIKE	CONC SAMP	CONC MS	% REC	CONC MSD	% REC	RPD	REC LIM	
=====											
1,2,4,-Trichlorobenzene			3830	0	3130	82	3250	85	4	23	38-107
Acenaphthene			3830	0	3740	98	3580	93	4	19	31-137
2,4-Dinitrotoluene			3830	0	6000	157	6170	161	3	47	28-89 *
Pyrene			3830	0	1480	39	1480	39	0	36	35-142
N-Nitrosodipropylamine			3830	0	4260	111	3940	103	8	38	41-126
1,4-Dichlorobenzene			3830	0	3320	87	3070	80	8	27	28-104
=====											
ACIDS			CONC SPIKE	CONC SAMP	CONC MS	% REC	CONC MSD	% REC	RPD	REC LIM	
=====											
Pentachlorophenol			7660	0	8100	106	7400	97	9	47	17-109
Phenol			7660	0	6240	81	5450	71	14	35	26-90
2-Chlorophenol			7660	0	4390	57	4080	53	7	50	25-102
p-Chloro-m-cresol			7660	0	7560	99	6980	91	8	33	26-103
4-Nitrophenol			7660	0	2440	32	2300	30	6	50	11-114

** outside QC limit - no action taken

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CLIENT Hart Crowser
1910 Fairview Ave. E.
Seattle, WA 98102
ATTN: Phillip Spadaro

LABORATORY NO. 98243

DATE Oct. 9, 1986

Job #1264-06

REPORT ON
SOIL

SAMPLE
IDENTIFICATION

Submitted 8/13/86 and identified as shown:

TESTS PERFORMED
AND RESULTS:

- 1) S-1A P-3 PAS 8/11 1400 1264-06
- 2) S-2A P-3 PAS 8/11 1400 1264-06
- 3) S-3A P-3 PAS 8/11 1400 1264-06
- 4) S-4A P-3 PAS 8/11 1400 1264-06
- 5) S-5A P-3 PAS 8/11 1400 1264-06
- 6) S-6A P-3 PAS 8/11 1400 1264-06

Samples were composited into one sample, designated composite "A".

An E.P. Toxicity extract was prepared from the sample in accordance with Test Methods for Evaluating Solid Wastes, U.S.E.P.A, July, 1982. method 1310.

The extract was then analyzed for priority pollutant metals + barium in accordance with the 7000 series of methods, and for pesticides/herbicides following method 8080 and 8150.

parts per million (mg/L)

	A	Lab Blank
Antimony	L/0.2	L/0.2
Arsenic	L/0.2	L/0.2
Beryllium	L/0.01	L/0.01
Cadmium	L/0.01	L/0.01
Chromium	L/0.1	L/0.1
Copper	L/0.1	L/0.1
Lead	0.1	L/0.1
Mercury	L/0.005	L/0.005



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LABORATORY NO. 98243

parts per million (mg/L)

	A	Lab Blank
Nickel	L/0.1	L/0.1
Selenium	L/0.2	L/0.2
Silver	L/0.1	L/0.1
Thallium	L/2.	L/2.
Zinc	0.2	L/0.1
Barium	0.2	L/0.1

	A
Endrin	L/0.0002
Methoxychlor	L/0.001
Toxaphene	L/0.01
2,4-D	L/0.002
2,4,5-TP (silvex)	L/0.001
Lindane	0.0004

Sample was analyzed for priority pollutants in accordance with Test Methods for Evaluating Solid Waste (SW-846) U.S.E.P.A. 1982 Method 8240 (volatile organics), 8270 (semi-volatile extractables), 8080 (pesticides and PCB's), 9010 (cyanide), and the 7000 series (metals analysis). Phenol analysis was in accordance with Method 420.2, Methods for Chemical Analysis of Water & Wastes, U.S.E.P.A., March, 1979.



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Hart Crowser

Inorganics

	A -----	Lab Blank -----
Total Solids, %	80.2	---
parts per billion (ug/kg), dry basis -----		
Antimony	L/3.	L/3.
Arsenic	1.7	L/0.5
Beryllium	0.4	L/0.1
Cadmium	8.3	L/0.5
Chromium	2800.	1.
Copper	58.	L/1.
Lead	8.	L/1.
Mercury	L/0.1	L/0.1
Nickel	36.	L/2.
Selenium	L/0.5	L/0.5
Silver	0.6	L/0.1
Thallium	L/0.5	L/0.5
Zinc	50.	L/1.
Total Cyanide	1.2	L/0.5
Total Phenol	1.0	L/0.5
Barium	29.	L/2.



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Volatile Organics (GC/MS)

parts per billion (ug/kg), dry basis

	A	Lab Blank
Chloromethane	L/1000.	L/5.
Bromomethane	L/1000.	L/5.
Vinyl Chloride	L/1000.	L/5.
Chloroethane	L/1000.	L/5.
Methylene Chloride	L/1000.	trace
Acrolein	L/5000.	L/25.
*Acetone	L/1000.	L/5.
Acrylonitrile	L/5000.	L/25.
*Carbon Disulfide	L/1000.	L/5.
1,1-Dichloroethylene	L/1000.	L/5.
1,1-Dichloroethane	L/1000.	L/5.
trans-1,2-Dichloroethylene	L/1000.	L/5.
Chloroform	L/1000.	L/5.
*2-Butanone	L/1000.	L/5.
1,2-Dichloroethane	L/1000.	L/5.
1,1,1-Trichloroethane	L/1000.	L/5.
*Vinyl Acetate	L/1000.	L/5.
Bromodichloromethane	L/1000.	L/5.
Carbon Tetrachloride	L/1000.	L/5.
1,2-Dichloropropane	L/1000.	L/5.
Trichloroethylene	trace	L/5.
Benzene	L/1000.	L/5.
Chlorodibromomethane	L/1000.	L/5.
1,1,2-Trichloroethane	L/1000.	L/5.
2-Chloroethyl vinyl ether	L/1000.	L/5.
Bromoform	L/1000.	L/5.
*4-Methyl-2-pentanone	L/1000.	L/5.



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LABORATORY NO. 98243

parts per billion (ug/kg), dry basis

	A	Lab Blank
	-----	-----
*2-Hexanone	L/1000.	L/5.
1,1,2,2-Tetrachloroethane	L/1000.	L/5.
Tetrachloroethylene	L/1000.	L/5.
Toluene	22,000.	L/5.
Chlorobenzene	L/1000.	L/5.
trans-1,3-Dichloropropene	L/1000.	L/5.
Ethylbenzene	5600.	L/5.
cis-1,3-Dichloropropene	L/1000.	L/5.
*Styrene	L/1000.	L/5.
*Total Xylenes	30,000.	L/5.

Extractables (by GC/MS)

parts per billion (ug/kg), dry basis

	A	Lab Blank
	-----	-----
N-nitrosodimethylamine	L/1600.	L/50.
Bis(2-chloroethyl)ether	L/1600.	L/50.
2-Chlorophenol	L/1600.	L/50.
Phenol	L/1600.	L/50.
1,3-Dichlorobenzene	L/1600.	L/50.
1,4-Dichlorobenzene	L/1600.	L/50.
1,2-Dichlorobenzene	L/1600.	L/50.
Bis(2-chloroisopropyl)ether	L/1600.	L/50.
Hexachloroethane	L/1600.	L/50.
N-nitroso-di-n-propylamine	L/1600.	L/50.



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Hart Crowser

LABORATORY NO. 98243

parts per billion (ug/kg), dry basis

	A	Lab Blank
	-----	-----
Nitrobenzene	L/1600.	L/50.
Isophorone	L/1600.	L/50.
2-Nitrophenol	L/1600.	L/50.
2,4-Dimethylphenol	L/1600.	L/50.
Bis(2-chloroethoxy)methane	L/1600.	L/50.
2,4-Dichlorophenol	L/1600.	L/50.
1,2,4-Trichlorobenzene	L/1600.	L/50.
Naphthalene	3000.	L/50.
Hexachlorobutadiene	L/1600.	L/50.
4-Chloro-m-cresol	L/1600.	L/50.
Hexachlorocyclopentadiene	L/1600.	L/50.
2,4,6-Trichlorophenol	L/1600.	L/50.
2-Chloronaphthalene	L/1600.	L/50.
Acenaphthylene	L/1600.	L/50.
Dimethylphthalate	L/1600.	L/50.
2,6-Dinitrotoluene	L/1600.	L/50.
Acenaphthene	5600.	L/50.
2,4-Dinitrophenol	L/1600.	L/50.
2,4-Dinitrotoluene	L/1600.	L/50.
4-Nitrophenol	L/1600.	L/50.
Fluorene	8100.	L/50.
4-Chlorophenyl phenyl ether	L/1600.	L/50.
Diethylphthalate	L/1600.	L/50.
4,6-Dinitro-o-cresol	L/1600.	L/50.
1,2-Diphenylhydrazine	L/1600.	L/50.
4-Bromophenyl phenyl ether	L/1600.	L/50.
Hexachlorobenzene	L/1600.	L/50.
Pentachlorophenol	L/1600.	L/50.
Phenanthrene	28,000.	L/50.
Anthracene	4800.	L/50.
Dibutylphthalate	L/1600.	L/50.



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parts per billion (ug/kg), dry basis

	A	Lab Blank
Fluoranthene	2200.	L/50.
Pyrene	8500.	L/50.
Benzidine	L/1600.	L/50.
Butyl benzyl phthalate	L/1600.	L/50.
Benzo(a)anthracene	L/1600.	L/50.
Chrysene	L/1600.	L/50.
3,3'-Dichlorobenzidine	L/1600.	L/50.
Bis(2-ethylhexyl)phthalate	3300.	L/50.
N-nitrosodiphenylamine	L/1600.	L/50.
Di-n-octyl phthalate	L/1600.	L/50.
Benzo(b)fluoranthene	L/1600.	L/50.
Benzo(k)fluoranthene	L/1600.	L/50.
Benzo(a)pyrene	2800.	L/50.
Indeno(1,2,3-cd)pyrene	L/1600.	L/50.
Dibenzo(ah)anthracene	L/1600.	L/50.
Benzo(ghi)perylene	L/1600.	L/50.
*Aniline	L/1600.	L/50.
*Benzoic Acid	L/1600.	L/50.
*Benzyl Alcohol	L/1600.	L/50.
*4-Chloroaniline	L/1600.	L/50.
*Dibenzofuran	L/1600.	L/50.
*2-Methylnaphthalene	21,000.	L/50.
*2-Methylphenol	L/1600.	L/50.
*4-Methylphenol	L/1600.	L/50.
*2-Nitroaniline	L/1600.	L/50.
*3-Nitroaniline	L/1600.	L/50.
*4-Nitroaniline	L/1600.	L/50.
*2,4,5-Trichlorophenol	L/1600.	L/50.



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Pesticides (by GC/ECD)

parts per billion (ug/kg), dry basis

	A	Lab Blank
alpha-BHC	L/8.	L/8.
beta-BHC	92.	L/8.
delta-BHC	L/8.	L/8.
gamma-BHC (lindane)	L/8.	L/8.
heptachlor	L/8.	L/8.
aldrin	L/8.	L/8.
heptachlor epoxide	L/8.	L/8.
dieldrin	L/16.	L/16.
4,4'-DDE	L/16.	L/16.
4,4'-DDD	L/16.	L/16.
endosulfan sulfate	L/16.	L/16.
4,4'-DDT	L/16.	L/16.
chlordane	L/80.	L/80.
alpha endosulfan	L/8.	L/8.
beta endosulfan	L/16.	L/16.
endrin	L/16.	L/16.
endrin aldehyde	L/16.	L/16.
toxaphene	L/160.	L/160.
PCB 1016	L/80.	L/80.
PCB 1221	L/80.	L/80.
PCB 1232	L/80.	L/80.
PCB 1242	L/80.	L/80.
PCB 1248	L/80.	L/80.
PCB 1254	L/160.	L/160.
PCB 1260	2200.	L/160.
Methoxychlor	L/20.	L/20.
Endrin Ketone	L/20.	L/20.



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Key

L/ indicates "less than"

* indicates additional compounds from the EPA's Hazardous Substances List.

trace indicates an unquantifiable amount between 1-10 parts per billion.

Respectfully submitted,

Laucks Testing Laboratories, Inc.


J. M. Owens

JMO:veg



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APPENDIX

Surrogate Recovery Quality Control Report

Listed below are surrogate (chemically similar) compounds utilized in the analysis of volatile and organic compounds. The surrogates are added to every sample prior to extraction and analysis to monitor for matrix effects, purging efficiency, and sample processing errors. The control limits represent the 95% confidence interval established in our laboratory through repetitive analysis of these sample types.

Sample No.	Surrogate Compound	Spike Level	Spike Found	% Recovery	Control Limit
<hr/>					
EP Tox		parts per million (mg/L)			
<hr/>					
A	Isodrin	0.000500	0.000532	106.	43-118
Blank	Isodrin	0.000500	0.000286	57.2	43-118
<hr/>					
Soils		parts per billion (ug/kg)			
<hr/>					
Blank	d4-1,2-Dichloroethane	50.0	50.0	100.	50-160
	d8-Toluene	50.0	48.9	97.8	50-160
	p-Bromofluorobenzene	50.0	46.7	93.4	50-160
A	d4-1,2-Dichloroethane	63,000.	63,800.	101.	50-160
	d8-Toluene	63,000.	60,900.	96.7	50-160
	p-Bromofluorobenzene	63,000.	68,600.	109.	50-160
Blank	2-Fluorophenol	3333.	2856.	85.7	25-121
	d5-Phenol	3333.	3333.	100.	24-113
	2-Bromophenol	3333.	2506.	75.2	59-97
	d5-Nitrobenzene	1667.	1467.	88.0	23-120
	2-Fluorobiphenyl	1667.	1625.	97.5	30-115
	d10-Azobenzene	1667.	1442.	86.5	---
	2,4,6-Tribromophenol	3333.	3026.	90.8	19-122
	d14-Terphenyl	1667.	1650.	99.0	18-137



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Sample No.	Surrogate Compound	Spike Level	Spike Found	% Recovery	Control Limit
parts per billion (ug/kg)					
A	2-Fluorophenol	4275.	*	*	25-121
	d5-Phenol	4275.	*	*	24-113
	2-Bromophenol	4275.	*	*	59-97
	d5-Nitrobenzene	2138.	*	*	23-120
	2-Fluorobiphenyl	2138.	2288.	107.	30-115
	d10-Azobenzene	2138.	1719.	80.4	---
	2,4,6-Tribromophenol	4275.	4245.	99.3	19-122
	d14-Terphenyl	2138.	2395.	112.	18-137
Blank	Isodrin	33.3	23.3	70.0	43-118**
A	Isodrin	42.8	31.8	74.3	43-118**
Blank	Dibutylchloredate	66.7	60.2	90.3	20-154
A	Dibutylchloredate	85.5	22.8	26.7	20-154

* Surrogates are added at a level appropriate to the average sample. In this case, concentration of analyte(s) present in the sample required that the sample be diluted prior to analysis. As a consequence, the surrogates were diluted as well and the resulting surrogate concentration was too low for accurate determination of recovery. Therefore, no surrogate recoveries are reported.

** Control limits are established when a sufficient number of analyses have been performed for an analyte in a specific matrix to allow development of a statistically meaningful figure. In this case, no control limits have been established in the soil matrix and the limits given are for a water matrix and should be regarded as estimates.



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Chemistry, Microbiology, and Technical Services

CLIENT Hart Crowser
1910 Fairview Ave. E.
Seattle, WA 98102
ATTN: Phillip Spadaro

LABORATORY NO. 98261

DATE Oct. 20, 1986

Job #1264-06

REPORT ON SOIL

SAMPLE
IDENTIFICATION

Submitted 8/13/86 and identified as shown:

TESTS PERFORMED
AND RESULTS:

- 1) PB-3 S-1 PAS 8/13 0730
- 2) PB-3 S-2 PAS 8/13 0800
- 3) PB-3 S-3 PAS 8/12 0815
- 4) PB-3 S-4 PAS 8/12 0830
- 5) PB-3 S-5 PAS 8/12 0850
- 6) PB-3 S-6 PAS 8/12 0900
- 7) PB-3 S-7 PAS 8/12 0920
- 8) PB-3 S-8 PAS 8/12 0945
- 9) PB-3 S-9 PAS 8/12 0950
- 10) PB-3 S-10 PAS 8/12 1030
- 11) PB-3 S-11 PAS 8/12 1100
- 12) PB-3 S-12 PAS 8/12 1140
- 13) PB-3 S-14 PAS 8/12 1445
- 14) PB-3 S-15 PAS 8/12 1513
- 15) PB-3 S-16 BEC 8/12

Samples 3-10 and 12-15 were held without analysis at your request.

An E.P. Toxicity extract was prepared from samples 1, 2, and 11 in accordance with Test Methods for Evaluating Solid Wastes, U.S.E.P.A, July, 1982. method 1310.

The extract was then analyzed for priority pollutant metals + barium in accordance with the 7000 series of methods, and for pesticides/herbicides following methods 8080 and 8150.



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	parts per million (mg/L)			
	1	2	11	Lab Blank
Antimony	L/0.2	L/0.2	L/0.2	L/0.2
Arsenic	L/0.2	L/0.2	L/0.2	L/0.2
Beryllium	L/0.01	L/0.01	L/0.01	L/0.01
Cadmium	L/0.01	L/0.01	L/0.01	L/0.01
Chromium	L/0.1	L/0.1	L/0.1	L/0.1
Copper	L/0.1	L/0.1	L/0.1	L/0.1
Lead	L/0.1	L/0.1	L/0.1	L/0.1
Mercury	L/0.005	L/0.005	L/0.005	L/0.005
Nickel	L/0.1	L/0.1	L/0.1	L/0.1
Selenium	L/0.2	L/0.2	L/0.2	L/0.2
Silver	L/0.1	L/0.1	L/0.1	L/0.1
Thallium	L/2.	L/2.	L/2.	L/2.
Zinc	L/0.1	L/0.1	L/0.1	L/0.1
Barium	0.1	0.1	0.1	L/0.1
Endrin	L/0.0002	L/0.0002	L/0.0002	
Methoxychlor	L/0.001	L/0.001	L/0.001	
Toxaphene	L/0.01	L/0.01	L/0.01	
2,4-D	L/0.0004	L/0.0004	L/0.0004	
2,4,5-TP (silvex)	L/0.0002	L/0.0002	L/0.0002	
Lindane	L/0.0004	L/0.0004	L/0.0004	



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Sample was analyzed for priority pollutants in accordance with Test Methods for Evaluating Solid Waste (SW-846) U.S.E.P.A. 1982 Method 8240 (volatile organics), 8270 (semi-volatile extractables), 8080 (pesticides and PCB's), 9010 (cyanide), and the 7000 series (metals analysis). Phenol analysis was in accordance with Method 420.2, Methods for Chemical Analysis of Water & Wastes, U.S.E.P.A., March, 1979.

Inorganics

	1	2	11	Lab Blank
	-----	-----	-----	-----
Total Solids, %	73.1	68.7	93.1	---
	parts per million (mg/kg), dry basis			
	-----	-----	-----	-----
Antimony	L/3.	L/3.	L/3.	L/3.
Arsenic	1.1	1.1	2.1	L/0.5
Beryllium	0.4	0.7	0.4	L/0.1
Cadmium	0.8	1.6	L/0.5	L/0.5
Chromium	1400.	1400.	22.	L/1.
Copper	180.	81.	14.	L/1.
Lead	4.	6.	4.	L/1.
Mercury	L/0.1	L/0.1	L/0.1	L/0.1
Nickel	34.	36.	17.	L/2.
Selenium	0.6	0.6	L/0.5	L/0.5
Silver	0.8	0.8	2.9	L/0.1
Thallium	L/0.5	L/0.5	L/0.5	L/0.5
Zinc	53.	62.	28.	L/1.
Total Cyanide	L/0.5	L/0.5	L/0.5	L/0.5
Total Phenol	4.8	0.5	L/0.5	L/0.5
Barium	110.	80.	37.	L/2.



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Volatile Organics (GC/MS)

parts per billion (ug/kg), dry basis

	1	2	11	Lab Blank
Chloromethane	L/5.	L/5.	L/5.	L/5.
Bromomethane	L/5.	L/5.	L/5.	L/5.
Vinyl Chloride	L/5.	L/5.	L/5.	L/5.
Chloroethane	L/5.	L/5.	L/5.	L/5.
Methylene Chloride	L/5.	L/5.	L/5.	L/5.
Acrolein	L/25.	L/25.	L/25.	L/25.
*Acetone	240.	110.	L/5.	L/5.
Acrylonitrile	L/25.	L/25.	L/25.	L/25.
*Carbon Disulfide	L/5.	L/5.	L/5.	L/5.
1,1-Dichloroethylene	L/5.	L/5.	L/5.	L/5.
1,1-Dichloroethane	L/5.	L/5.	L/5.	L/5.
trans-1,2-Dichloroethylene	trace	trace	L/5.	L/5.
Chloroform	L/5.	L/5.	L/5.	L/5.
*2-Butanone	L/5.	L/5.	L/5.	L/5.
1,2-Dichloroethane	L/5.	L/5.	L/5.	L/5.
1,1,1-Trichloroethane	L/5.	L/5.	L/5.	L/5.
*Vinyl Acetate	L/5.	L/5.	L/5.	L/5.
Bromodichloromethane	L/5.	L/5.	L/5.	L/5.
Carbon Tetrachloride	L/5.	L/5.	L/5.	L/5.
1,2-Dichloropropane	L/5.	L/5.	L/5.	L/5.
Trichloroethylene	trace	trace	L/5.	L/5.
Benzene	L/5.	L/5.	L/5.	L/5.
Chlorodibromomethane	L/5.	L/5.	L/5.	L/5.
1,1,2-Trichloroethane	L/5.	L/5.	L/5.	L/5.
2-Chloroethyl vinyl ether	L/5.	L/5.	L/5.	L/5.
Bromoform	L/5.	L/5.	L/5.	L/5.



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parts per billion (ug/kg), dry basis

	1	2	11	Lab Blank
*4-Methyl-2-pentanone	31.	L/5.	L/5.	L/5.
*2-Hexanone	L/5.	L/5.	L/5.	L/5.
1,1,2,2-Tetrachloroethane	L/5.	L/5.	L/5.	L/5.
Tetrachloroethylene	L/5.	L/5.	L/5.	L/5.
Toluene	L/5.	L/5.	L/5.	L/5.
Chlorobenzene	L/5.	L/5.	L/5.	L/5.
trans-1,3-Dichloropropene	L/5.	L/5.	L/5.	L/5.
Ethylbenzene	L/5.	L/5.	L/5.	L/5.
cis-1,3-Dichloropropene	L/5.	L/5.	L/5.	L/5.
*Styrene	L/5.	L/5.	L/5.	L/5.
*o-Xylene	L/5.	L/5.	L/5.	L/5.

Extractables (by GC/MS)

parts per billion (ug/kg), dry basis

	1	2	11	Lab Blank
N-nitrosodimethylamine	L/60.	L/60.	L/50.	L/50.
Bis(2-chloroethyl)ether	L/60.	L/60.	L/50.	L/50.
2-Chlorophenol	L/60.	L/60.	L/50.	L/50.
Phenol	2900.	L/60.	L/50.	L/50.
1,3-Dichlorobenzene	L/60.	L/60.	L/50.	L/50.
1,4-Dichlorobenzene	L/60.	L/60.	L/50.	L/50.
1,2-Dichlorobenzene	L/60.	L/60.	L/50.	L/50.
Bis(2-chloroisopropyl)ether	L/60.	L/60.	L/50.	L/50.
Hexachloroethane	L/60.	L/60.	L/50.	L/50.



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parts per billion (ug/kg), dry basis.

	1	2	11	Lab Blank
N-nitroso-di-n-propylamine	L/60.	L/60.	L/50.	L/50.
Nitrobenzene	L/60.	L/60.	L/50.	L/50.
Isophorone	L/60.	L/60.	L/50.	L/50.
2-Nitrophenol	L/60.	L/60.	L/50.	L/50.
2,4-Dimethylphenol	L/60.	L/60.	L/50.	L/50.
Bis(2-chloroethoxy)methane	L/60.	L/60.	L/50.	L/50.
2,4-Dichlorophenol	L/60.	L/60.	L/50.	L/50.
1,2,4-Trichlorobenzene	L/60.	L/60.	L/50.	L/50.
Naphthalene	L/60.	L/60.	L/50.	L/50.
Hexachlorobutadiene	L/60.	L/60.	L/50.	L/50.
4-Chloro-m-cresol	L/60.	L/60.	L/50.	L/50.
Hexachlorocyclopentadiene	L/60.	L/60.	L/50.	L/50.
2,4,6-Trichlorophenol	L/60.	L/60.	L/50.	L/50.
2-Chloronaphthalene	L/60.	L/60.	L/50.	L/50.
Acenaphthylene	L/60.	L/60.	L/50.	L/50.
Dimethylphthalate	L/60.	L/60.	L/50.	L/50.
2,6-Dinitrotoluene	L/60.	L/60.	L/50.	L/50.
Acenaphthene	L/60.	L/60.	L/50.	L/50.
2,4-Dinitrophenol	L/60.	L/60.	L/50.	L/50.
2,4-Dinitrotoluene	L/60.	L/60.	L/50.	L/50.
4-Nitrophenol	L/60.	L/60.	L/50.	L/50.
Fluorene	L/60.	L/60.	L/50.	L/50.
4-Chlorophenyl phenyl ether	L/60.	L/60.	L/50.	L/50.
Diethylphthalate	L/60.	L/60.	L/50.	L/50.
4,6-Dinitro-o-cresol	L/60.	L/60.	L/50.	L/50.
1,2-Diphenylhydrazine	L/60.	L/60.	L/50.	L/50.
4-Bromophenyl phenyl ether	L/60.	L/60.	L/50.	L/50.
Hexachlorobenzene	L/60.	L/60.	L/50.	L/50.



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Chemistry, Microbiology and Technical Services



Certificate

PAGE NO. 7

Hart Crowser

LABORATORY NO. 98261

parts per billion (ug/kg), dry basis

	1	2	11	Lab Blank
Pentachlorophenol	L/60.	L/60.	L/50.	L/50.
Phenanthrene	L/60.	80.	L/50.	L/50.
Anthracene	L/60.	L/60.	L/50.	L/50.
Dibutylphthalate	L/60.	60.	L/50.	L/50.
Fluoranthene	L/60.	L/60.	L/50.	L/50.
Pyrene	L/60.	L/60.	L/50.	L/50.
Benzidine	L/60.	L/60.	L/50.	L/50.
Butyl benzyl phthalate	L/60.	L/60.	L/50.	L/50.
Benzo(a)anthracene	L/60.	L/60.	L/50.	L/50.
Chrysene	L/60.	L/60.	L/50.	L/50.
3,3'-Dichlorobenzidine	L/60.	L/60.	L/50.	L/50.
Bis(2-ethylhexyl)phthalate	170.	130.	1500.	440.
N-nitrosodiphenylamine	L/60.	L/60.	L/50.	L/50.
Di-n-octyl phthalate	L/60.	L/60.	100.	L/50.
Benzo(b)fluoranthene	L/60.	L/60.	L/50.	L/50.
Benzo(k)fluoranthene	L/60.	L/60.	L/50.	L/50.
Benzo(a)pyrene	L/60.	L/60.	L/50.	L/50.
Indeno(1,2,3-cd)pyrene	L/60.	L/60.	L/50.	L/50.
Dibenzo(ah)anthracene	L/60.	L/60.	L/50.	L/50.
Benzo(ghi)perylene	L/60.	L/60.	L/50.	L/50.
*Aniline	L/60.	L/60.	L/50.	L/50.
*Benzoic Acid	L/60.	360.	L/50.	L/50.
*Benzyl Alcohol	L/60.	L/60.	L/50.	L/50.
*4-Chloroaniline	L/60.	L/60.	L/50.	L/50.
*Dibenzofuran	L/60.	L/60.	L/50.	L/50.
*2-Methylnaphthalene	L/60.	L/60.	L/50.	L/50.
*2-Methylphenol	L/60.	L/60.	L/50.	L/50.
*4-Methylphenol	L/60.	L/60.	L/50.	L/50.
*2-Nitroaniline	L/60.	L/60.	L/50.	L/50.
*3-Nitroaniline	L/60.	L/60.	L/50.	L/50.
*4-Nitroaniline	L/60.	L/60.	L/50.	L/50.
*2,4,5-Trichlorophenol	L/60.	L/60.	L/50.	L/50.



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Hart Crowser

LABORATORY NO. 98261

Pesticides (by GC/ECD)

parts per billion (ug/kg), dry basis

	1	2	11	Lab Blank
alpha-BHC	L/8.0	L/8.0	L/8.0	L/8.0
beta-BHC	L/8.0	L/8.0	L/8.0	L/8.0
delta-BHC	L/8.0	L/8.0	L/8.0	L/8.0
gamma-BHC (lindane)	L/8.0	L/8.0	L/8.0	L/8.0
heptachlor	L/8.0	L/8.0	L/8.0	L/8.0
aldrin	L/8.0	L/8.0	L/8.0	L/8.0
heptachlor epoxide	L/8.0	L/8.0	L/8.0	L/8.0
dieldrin	L/16.0	L/16.0	L/16.0	L/16.0
4,4'-DDE	L/16.0	L/16.0	L/16.0	L/16.0
4,4'-DDD	L/16.0	L/16.0	L/16.0	L/16.0
endosulfan sulfate	L/16.0	L/16.0	L/16.0	L/16.0
4,4'-DDT	L/16.0	L/16.0	L/16.0	L/16.0
chlordan	L/80.0	L/80.0	L/80.0	L/80.0
alpha endosulfan	L/8.0	L/8.0	L/8.0	L/8.0
beta endosulfan	L/16.0	L/16.0	L/16.0	L/16.0
endrin	L/16.0	L/16.0	L/16.0	L/16.0
endrin aldehyde	L/16.0	L/16.0	L/16.0	L/16.0
toxaphene	L/160.0	L/160.0	L/160.0	L/160.0
PCB 1016	L/80.0	L/80.0	L/80.0	L/80.0
PCB 1221	L/80.0	L/80.0	L/80.0	L/80.0
PCB 1232	L/80.0	L/80.0	L/80.0	L/80.0
PCB 1242	L/80.0	L/80.0	L/80.0	L/80.0
PCB 1248	L/80.0	L/80.0	L/80.0	L/80.0
PCB 1254	L/160.0	L/160.0	L/160.0	L/160.0
PCB 1260	L/160.0	L/160.0	L/160.0	L/160.0
Endrin Ketone	L/16.	L/16.	L/16.	L/16.
Methoxychlor	L/25.	L/25.	L/25.	L/25.



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Key

L/ indicates "less than"

* indicates additional compounds from the EPA's Hazardous Substances List.

trace indicates an unquantifiable amount between 5-25 parts per billion.

Respectfully submitted,

Laucks Testing Laboratories, Inc.

J. M. Owens

JMO:veg



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APPENDIX

Surrogate Recovery Quality Control Report

Listed below are surrogate (chemically similar) compounds utilized in the analysis of volatile and organic compounds. The surrogates are added to every sample prior to extraction and analysis to monitor for matrix effects, purging efficiency, and sample processing errors. The control limits represent the 95% confidence interval established in our laboratory through repetitive analysis of these sample types.

Sample No.	Surrogate Compound	Spike Level	Spike Found	% Recovery	Control Limit
		parts per billion (ug/kg)			
Blank	d4-1,2-Dichloroethane	50.0	48.8	97.6	50-160
	d8-Toluene	50.0	49.6	99.2	50-160
	p-Bromofluorobenzene	50.0	50.6	101.	50-160
1	d4-1,2-Dichloroethane	287.	289.	101.	50-160
	d8-Toluene	287.	276.	96.2	50-160
	p-Bromofluorobenzene	287.	283.	98.6	50-160
2	d4-1,2-Dichloroethane	223.	219.	98.2	50-160
	d8-Toluene	223.	219.	98.2	50-160
	p-Bromofluorobenzene	223.	223.	100.	50-160
11	d4-1,2-Dichloroethane	118.	119.	101.	50-160
	d8-Toluene	118.	117.	99.2	50-160
	p-Bromofluorobenzene	118.	118.	100.	50-160



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Sample No.	Surrogate Compound	Spike Level	Spike Found	% Recovery	Control Limit
-----	-----	-----	-----	-----	-----
parts per billion (ug/kg)					

Blank	2-Fluorophenol	3333.	2853.0	85.6	25-121
	d5-Phenol	3333.	3433.0	103.0	24-113
	2-Bromophenol	3333.	2763.1	82.9	59-97
	d5-Nitrobenzene	1667.	1465.3	87.9	23-120
	2-Fluorobiphenyl	1667.	1510.3	90.6	30-115
	d10-Azobenzene	1667.	1477.0	88.6	---
	2,4,6-Tribromophenol	3333.	2593.1	77.8	19-122
	d14-Terphenyl	1667.	1712.0	102.7	18-137
1	2-Fluorophenol	4444.	3768.5	84.8	25-121
	d5-Phenol	4444.	4177.4	94.0	24-113
	2-Bromophenol	4444.	3453.0	77.7	59-97
	d5-Nitrobenzene	2222.	1897.6	85.4	23-120
	2-Fluorobiphenyl	2222.	1855.4	83.5	30-115
	d10-Azobenzene	2222.	2233.1	100.5	---
	2,4,6-Tribromophenol	4444.	4119.6	92.7	19-122
	d14-Terphenyl	2222.	2406.4	108.3	18-137
2	2-Fluorophenol	4651.	3581.3	77.0	25-121
	d5-Phenol	4651.	4260.3	91.6	24-113
	2-Bromophenol	4651.	3283.6	70.6	59-97
	d5-Nitrobenzene	2326.	1888.7	81.2	23-120
	2-Fluorobiphenyl	2326.	2005.0	86.2	30-115
	d10-Azobenzene	2326.	2251.6	96.8	---
	2,4,6-Tribromophenol	4651.	3451.0	74.2	19-122
	d14-Terphenyl	2326.	2405.1	103.4	18-137



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Hart Crowser

LABORATORY NO. 98261

Sample No.	Surrogate Compound	Spike Level	Spike Found	% Recovery	Control Limit
parts per billion (ug/kg)					
11	2-Fluorophenol	3636.	2545.2	70.0	25-121
	d5-Phenol	3636.	2967.0	81.6	24-113
	2-Bromophenol	3636.	2334.3	64.2	59-97
	d5-Nitrobenzene	1818.	1325.3	72.9	23-120
	2-Fluorobiphenyl	1818.	1338.0	73.6	30-115
	d10-Azobenzene	1818.	1596.2	87.8	---
	2,4,6-Tribromophenol	3636.	2283.4	62.8	19-122
	d14-Terphenyl	1818.	1921.6	105.7	18-137
Blank	2,4,5-T	0.0100	0.0071	71.	28-128
1	2,4,5-T	0.0100	0.0086	86.	28-128
2	2,4,5-T	0.0100	0.0065	65.	28-128
11	2,4,5-T	0.0100	0.0092	92.	28-128
Blank	Dibutylchloredate	66.7	62.8	94.1	20-154*
1	Dibutylchloredate	88.9	85.0	95.6	20-154*
2	Dibutylchloredate	93.0	70.9	76.2	20-154*
11	Dibutylchloredate	72.7	67.9	93.4	20-154*
Blank	Isodrin	33.3	25.3	76.0	43-118**
1	Isodrin	44.4	35.0	78.8	43-118**
2	Isodrin	46.5	27.7	59.6	43-118**
11	Isodrin	36.4	24.4	67.0	43-118**

* Control limits are established when a sufficient number of analyses have been performed for an analyte in a specific matrix to allow development of a statistically meaningful figure. In this case, no control limits have been established in the soil matrix and the limits given are for a water matrix and should be regarded as estimates.

** DBC concentration and percent recovery calculated from DB-5 column due to co-elution of compound with DBC on packed column.



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J-1264-08

APPENDIX D

GEOMEMBRANE QUALITY CONTROL TEST DATA

Quality Control Field Seams by Northwest Laboratories

Five pages of test data.

Quality Control Test Data by BF Goodrich

Four pages of test data.

Quality Control Factory Seams by Staff Industries

One page of test data.

NORTHWEST LABORATORIES

of Seattle, Incorporated

ESTABLISHED 1896



Technical Services for: Industry, Commerce, Legal Profession & Insurance Industry

1530 FIRST AVENUE SOUTH
Report to: Northwest Linings SEATTLE, WASHINGTON 98134

Date: October 14, 1986 Telephone: (206) 622-0680

Report On: PVC PO# 1780

Lab No.: E 36944-1

IDENTIFICATION:

Welded 30 mil PVC Liner material Joints were Submitted for Peel & Tensile Testing.
Project: Queen City

Test Procedure ASTM D-3083 Modified and ASTM D-413 Modified

TEST RESULTS:

	<u>Tensile Strength Lbs/Linear Inch</u>	<u>Location of Failure</u>
A-B Butt		
Tensile		
1	82	Fabric at Seam
2	78	Fabric at Seam
3	86	Fabric at Grip
Average	82.0	
Peel		
4	29	Glue Line
5	36	Fabric in Glue Line
Average	32.5	
B-B C-Butt		
Tensile		
1	68	Fabric at Seam
2	77	Fabric at Seam
3	80	Fabric at Seam
Average	75.6	
Peel		
4	25	Glue Line
5	29	Glue Line
Average	27.0	
DE-W		
Tensile		
1	60	Fabric at Seam
2	64	Fabric at Seam
3	74	Fabric at Seam
Average	66.0	
Peel		
4	21	Glue Line
5	18	Glue Line
Average	22.0	

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Technical Services for: Industry, Commerce, Legal Profession & Insurance Industry

1530 FIRST AVENUE SOUTH

SEATTLE, WASHINGTON 98134

Telephone: (206) 622-0680

Report To: Northwest Linings

Date: October 14, 1986

Report On: PVC PO# 1780

Lab No.: E 36944-2

IDENTIFICATION:

Welded 30 mil PVC Liner material Joints were Submitted for Peel & Tensile Testing.
Project: Queen City

Test Procedure ASTM D-3083 Modified and ASTM D-413 Modified

TEST RESULTS:

	<u>Tensile Strength Lbs/Linear Inch</u>	<u>Location of Failure</u>
DE-E		
Tensile		
1	75	Fabric at Seam
2	71	Fabric at Seam
3	66	Fabric at Seam
Average	70.6	
Peel		
4	26	Glue Line
5	24	Glue Line
Average	25.0	
DG-Butt		
Tensile		
1	85	Fabric at Seam
2	76	Fabric at Seam
3	67	Fabric at Seam
Average	76.0	
Peel		
4	26	Fabric at Seam
5	23	Fabric at Glue Line
6	21	Glue Line
Average	23.3	
GH-W		
Tensile		
1	61	Fabric at Seam
2	66	Fabric at Seam
3	69	Fabric at Seam
Average	65.3	
Peel		
4	12	Glue Line
5	17	Glue Line
6	22	Glue Line
Average	17.0	

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Technical Services for: Industry, Commerce, Legal Profession & Insurance Industry

1530 FIRST AVENUE SOUTH

SEATTLE, WASHINGTON 98134

Telephone: (206) 622-0680

Report To: Northwest Linings

Date: October 14, 1986

Report On: PVC PO# 1780

Lab No.: E 36944-3

IDENTIFICATION:

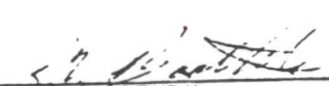
Welded 30 mil PVC Liner material Joints were Submitted for Peel & Tensile Testing.
Project: Queen City

Test Procedure ASTM D-3083 Modified and ASTM D-413 Modified

TEST RESULTS:

	<u>Tensile Strength Lbs/Linear Inch</u>	<u>Location of Failure</u>
GH-E		
Tensile		
1	61	Fabric at Seam
2	68	Fabric at Seam
3	67	Fabric at Seam
Average	65.3	
Peel		
4	10	Glue Line
5	8	Glue Line
6	10	Glue Line
Average	9.3	
H		
EX-Butt		
Tensile		
1	72	Fabric at Seam
2	74	Fabric 1/2" From Seam
3	73	Fabric at Seam
Average	73.0	
Peel		
4	22	Fabric at Glue Line
5	20	Glue Line
Average	21.0	

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Technical Services for: Industry, Commerce, Legal Profession & Insurance Industry



1530 FIRST AVENUE SOUTH

SEATTLE, WASHINGTON 98134

Telephone: (206) 622-0680

Report To: Northwest Linings & Geotextite Products, Inc Date: October 30, 1986

Report On: PVC P.O. #1803

Revised: November 4, 1986

Lab No.: E 37097

IDENTIFICATION:

Welded 30mil PVC Liner Material Joints were submitted for tensile and peel testing.

Test Procedure ASTM D -3083 Modified & D -413 Modified - Project: Queen City

TEST RESULTS:

<u>Set #'s</u>	<u>Tensile Strength Lbs/Linear Inch</u>	<u>Location of Failure</u>
JH-E1 Peel 30		glueline
2 18		glueline
3 25		glueline
Average 24.3		
4 Tensile 68		Fabric at seam
5 72		Fabric at seam
6 65		Fabric at seam
Average 68.3		
JH-W 1 Peel 23		Glueline
2 20		Glueline
3 20		Glueline
Average 21.0		
4 Tensile 66		Fabric at seam
5 61		Fabric at seam
6 61		Fabric at seam
Average 62.6		
FI-W 1 Peel 12		Glueline
2 13		Glueline
3 21		Glueline
Average 15.3		
4 Tensile 67		Fabric at seam
5 60		Fabric at seam
6 70		Fabric at seam
Average 65.7		
FJ 1 Peel 25		Glueline
2 25		Glueline
3 16		Glueline
Average 22.0		
4 Tensile 83		Fabric at seam
5 84		Fabric at seam
6 89		Fabric at seam
Average 85.3		

NORTHWEST LABORATORIES

of Seattle, Incorporated

E 37097
Page Two

✓ I-TR	1	Peel	14	Glueline
	2		26	Glueline
	3		22	Glueline
	Average		20.7	
	4	Tensile	75	Fabric at seam
	5		66	Fabric at seam
	6		67	Fabric at seam
	Average		69.3	
◇ BK	1	Peel	17	Glueline
	2		20	Glueline
	3		20	Glueline
	Average		19.0	
	4	Tensile	64	Fabric at seam
	5		68	Fabric at seam
	6		66	Fabric at seam
	Average		66.0	
✓ KJ	1	Peel	17	Glueline
	2		16	Glueline
	3		15	Glueline
	Average		16.0	
	4	Tensile	73	Fabric at seam
	5		76	Fabric at seam
	6		75	Fabric at seam
	Average		74.7	
EF-E	1	Peel	28	Glueline
	2		27	Glueline
	3		26	Glueline
	Average		27.0	
	4	Tensile	72	Fabric at seam
	5		66	Fabric at seam
	6		70	Fabric at seam
	Average	69.3		
EF-W	1	Peel	24	Glueline
	2		26	Glueline
	3		26	Glueline
	Average		25.3	
	4	Tensile	72	Fabric at seam
	5		70	Fabric at seam
	6		83	Fabric at seam
	Average		75.0	

NORTHWEST LABORATORIES


R.V. BOOTHBY

n1

August 1, 1986

LABORATORY TEST REPORT 30 MIL VINYL SHEET

<u>Physical Properties</u>		<u>Requirement</u>	<u>Test Method</u>	<u>Test Results</u>
Specific Gravity		1.24-1.30	BFG Method	1.25
Thickness (Inches)		$\pm 5\%$	ASTM D1593	.0306
Tensile (psi, Min.)	M	2400	ASTM D882	2605
	T	2400		2470
Elongation (% , Min.)	M	400	ASTM D882	550
	T	400		580
100% Modulus (psi, Range)	M	1000-1600	ASTM D882	1130
	T	1000-1600		1050
Graves Tear	M	320	ASTM D1004-49T	367
(Lbs./In., Min.)	T	320		347
Water Extraction (% , Max.)		0.35	ASTM D1239	+0.34
Volatility (% , Max.)		0.70	ASTM D1203-55T	0.60
Impact Cold Crack ($^{\circ}$ F, Max.)		-20	ASTM D1790	Material passes
Dimensional Stability	M	5	ASTM D1204	-1.6
(% , Max.)	T	5	100 $^{\circ}$ C/15 Min.	+1.1
Shore Durometer "A" (Range)		93 \pm 3	ASTM D676	91
Outdoor Exposure (Sun Hours)		1500	)	Formulation
Resistance to Burial		Pass USBR	)	used
Alkali Resistance		Pass CRD-572-61	) -	previously
			)	tested
			)	satisfactorily
Pinholes/10 Sq.Yd. (Max.)		1		OK

Spec Number : 64-03-4730-92-3
Compound Number: 23-677
Production Date: June 11, 1986
Roll Numbers : 347275 representing
347260 through 347280
and 14645 through 14679

BFGoodrich Company
Industrial Products Division

Thomas R. Ward
Thomas R. Ward
Technical Manager

TRW:mbf

BFGoodrich

The BFGoodrich Company
P. O. Box 657
Marietta, Ohio 45750

August 1, 1986

LABORATORY TEST REPORT 30 MIL VINYL SHEET

<u>Physical Properties</u>		<u>Requirement</u>	<u>Test Method</u>	<u>Test Results</u>
Specific Gravity		1.24-1.30	BFG Method	1.26
Thickness (Inches)		$\pm 5\%$	ASTM D1593	.0299
Tensile (psi, Min.)	M	2400	ASTM D882	2910
	T	2400		2720
Elongation (% , Min.)	M	400	ASTM D882	555
	T	400		560
100% Modulus (psi, Range)	M	1000-1600	ASTM D882	1118
	T	1000-1600		1075
Graves Tear	M	320	ASTM D1004-49T	398
(Lbs./In., Min.)	T	320		385
Water Extraction (% , Max.)		0.35	ASTM D1239	+0.28
Volatility (% , Max.)		0.70	ASTM D1203-55T	0.62
Impact Cold Crack ($^{\circ}$ F, Max.)		-20	ASTM D1790	Material passes
Dimensional Stability	M	5	ASTM D1204	-2.4
(% , Max.)	T	5	100 $^{\circ}$ C/15 Min.	+0.9
Shore Durometer "A" (Range)		93 \pm 3	ASTM D676	92
Outdoor Exposure (Sun Hours)		1500	)	Formulation
			)	used
Resistance to Burial		Pass USBR	) -	previously
			)	tested
Alkali Resistance		Pass CRD-572-61	)	satisfactorily
Pinholes/10 Sq.Yd. (Max.)		1		OK

Spec Number : 64-03-3730-92-3
Compound Number: 23-677
Production Date: June 19, 1986
Roll Numbers : 14570 representing
14556 through 14644

BFGoodrich Company
Industrial Products Division

Thomas R. Ward
Thomas R. Ward
Technical Manager

TRW:mbf

BFGoodrich

The BFGoodrich Company
P. O. Box 657
Marietta, Ohio 45750

August 1, 1986

LABORATORY TEST REPORT 30 MIL VINYL SHEET

<u>Physical Properties</u>		<u>Requirement</u>	<u>Test Method</u>	<u>Test Results</u>
Specific Gravity		1.24-1.30	BFG Method	1.26
Thickness (Inches)		$\pm 5\%$	ASTM D1593	.0304
Tensile (psi, Min.)	M	2400	ASTM D882	2865
	T	2400		2525
Elongation (% , Min.)	M	400	ASTM D882	525
	T	400		495
100% Modulus (psi, Range)	M	1000-1600	ASTM D882	1245
	T	1000-1600		1219
Graves Tear	M	320	ASTM D1004-49T	390
(Lbs./In., Min.)	T	320		361
Water Extraction (% , Max.)		0.35	ASTM D1239	+0.24
Volatility (% , Max.)		0.70	ASTM D1203-55T	0.49
Impact Cold Crack ($^{\circ}$ F, Max.)		-20	ASTM D1790	Material Passes
Dimensional Stability	M	5	ASTM D1204	-2.2
(% , Max.)	T	5	100 $^{\circ}$ C/15 Min.	+0.8
Shore Durometer "A" (Range)		93 ± 3	ASTM D676	91
Outdoor Exposure (Sun Hours)		1500	)	Formulation
Resistance to Burial		Pass USBR	)	used
Alkali Resistance		Pass CRD-572-61	) -	previously
			)	tested
			)	satisfactorily
Pinholes/10 Sq.Yd. (Max.)		1		OK

Spec Number : 64-03-3730-92-3
Compound Number: 23-677
Production Date: July 19, 1986
Roll Numbers : 341471 representing
341441 through 341509

BFGoodrich Company
Industrial Products Division

Thomas R. Ward
Thomas R. Ward
Technical Manager

TRW:mbf

BFGoodrich

The BFGoodrich Company
P. O. Box 657
Marietta, Ohio 45750

August 1, 1986

LABORATORY TEST REPORT 30 MIL VINYL SHEET

Physical Properties		Requirement	Test Method	Test Results
Specific Gravity		1.24-1.30	BFG Method	1.26
Thickness (Inches)		$\pm 5\%$	ASTM D1593	.0307
Tensile (psi, Min.)	M	2400	ASTM D882	2800
	T	2400		2645
Elongation (% , Min.)	M	400	ASTM D882	520
	T	400		550
100% Modulus (psi, Range)	M	1000-1600	ASTM D882	1255
	T	1000-1600		1180
Graves Tear (Lbs./In., Min.)	M	320	ASTM D1004-49T	361
	F	320		385
Water Extraction (% , Max.)		0.35	ASTM D1239	+0.25
Volatility (% , Max.)		0.70	ASTM D1203-55T	0.57
Impact Cold Crack ($^{\circ}$ F, Max.)		-20	ASTM D1790	Material Passes
Dimensional Stability (% , Max.)	M	.5	ASTM D1204	-2.6
	T	5	100 $^{\circ}$ C/15 Min.	+0.9
Shore Durometer "A" (Range)		93 ± 3	ASTM D676	91
Outdoor Exposure (Sun Hours)		1500	)	Formulation
			)	used
Resistance to Burial		Pass USBR	) -	previously
			)	tested
Alkali Resistance		Pass CRD-572-61	)	satisfactorily
Pinholes/10 Sq.Yd. (Max.)		1		OK

Spec Number : 64-03-3730-92-3
Compound Number: 23-677
Production Date: July 21, 1986
Roll Numbers : 9522 representing
14680 through 14736 and
9495 through 9576

BFGoodrich Company
Industrial Products Division

Thomas R. Ward

Thomas R. Ward
Technical Manager

TRW:mbf

STAFF INDUSTRIES INC. 240 Chene Street • Detroit, Michigan 48207 • Telephone (313) 259-1821

August 12, 1986

Mr. Rod W. Newton
Northwest Linings
20222 87th Avenue South
Kent, Washington 98032

Re: Seam Certification/Test Results
J-7283 - Queen City Farm Landfill

Dear Rod;

Attached please find results for 30 mil PVC seam samples as specified in the above referenced project. Documents, the samples, and results obtained are representative of the material and seams used and fabricated for this project.

Very truly yours,

STAFF INDUSTRIES, INC.

Gary M. Lechner
Credit Manager

GML/dw

Encl.

cc: J-7283

J-7283 - August 12, 1986

Sample No.	Test Method	Test Result	Comments
1	ASTM D 882	69 ppi	pass
2	"	58 ppi	pass
3	"	64 ppi	pass
4	"	74 ppi	pass
5	"	66 ppi	pass
6	"	68 ppi	pass
7	"	67 ppi	pass
8	"	65 ppi	pass
9	"	75 ppi	pass
10	"	<u>69 ppi</u>	pass

Average Test REsult 67.5 ppi

Description of sample:

10 pieces 30 mil PVC from 12" width strip cut from between blankets
No. 2-2/2-3 run sheet 3699.

Test Requirements:

Seam strength 55.2 lbs/in

J-1264-08

APPENDIX E

HYDROSEED APPLICATION DATA

Table E-1 - Hydroseed Data

Table E-1 - Hydroseed Data

	<u>Specified</u>	<u>Application</u>
o <u>Seed</u>		
Material		Grass Master Erosion Control Seed Mix Supplied by D-F Marks Co. 29.99% Perennial Rye Grass 29.61% Red Creep Fescue 19.76% Annual Rye Grass 9.96% White Clover 9.96% Highland Bent Grass 0.20% Crop Seed 0.49 Inert matter 0.02 Weed Seed
Application Rate	100 Pounds per acre	200 Pounds per acre
o <u>Mulch</u>		
Material	Wood Fiber	Weyerhaeuser Silva Fiber
Application Rate	200 Pounds per acre	200 Pounds per acre
o <u>Fertilization</u>		
Material	10-20-30 Nitrogen-Phosphoric Acid-Potash 50% Nitrogen from Ureaformaldehyde	16-16-16 50% Nitrogen SCU
Application Rate	500 Pounds per acre	640 Pounds per acre

Data provided by Grass Master and compiled by Hart Crowser, Inc.

J-1264-08

APPENDIX F
FIELD MODIFICATIONS

Field Modification

<u>Number</u>	<u>Date</u>	<u>Subject</u>
1	05/06/86	Excavation Start after Final Design Approval
2	05/06/86	Pond No. 1 and Pond No. 2 Working Surface Soils
3	05/06/86	Borings Start after Pond 2 at NWES Option
4	05/06/86	Wood Chip Material Transported Off Site
5	05/06/86	Monitoring Well Installation as Soon as Possible
6	05/06/86	Sequential Cover System Installation
7	05/27/86	Pond No. 1 and Pond No. 2 Sampling Plan
8	05/28/86	Pond No. 2 Bottom Stabilization
9	09/09/86	Silt Cover Soils
10	11/04/86	Top Soil Cover - 6 inches Sand and Gravel
11	<u>11/04/86</u>	Rock Riprap Northwest Corner

NORTHWEST ENVIROSERVICE INC.

QUEEN CITY FARMS

WORK PLAN FIELD MODIFICATION FORM

Field Mod. No. 1

Date: 5/06/86

SUBJECT: Excavation Start after Final Design Approval

DESCRIPTION OF FIELD MODIFICATION: _____

It is desirable to expedite completion of the Remedial Action
authorized by the Work Plan. To accomplish this, it is now
planned to perform certain tasks concurrently rather than in
series as was originally considered by the Work Plan.

Initially, the Work Plan considered that the installation of the
Permanent Upgradient Diversion System would start after Pond #3
sludge was removed, processed, and hauled off-site (page 15 -
Work Plan). It is now recognized that excavation for the
system can and should be started immediately after approval of the
final design.

It is the consensus of the designated Project Coordinators and
the On-Scene Coordinators that this modification be implemented

QCF PROJECT COORDINATOR: _____

EPA PROJECT COORDINATOR: _____

DOE PROJECT COORDINATOR: _____

[Signature]
[Signature]
[Signature]

NORTHWEST ENVIROSERVICE INC.

QUEEN CITY FARMS

WORK PLAN FIELD MODIFICATION FORM

Field Mod. No. 2

Date: 05/06/86

SUBJECT: Ponds 1 & 2 Working Surface Soils

DESCRIPTION OF FIELD MODIFICATION: _____

It is desirable to expedite completion of the Remedial Action authorized by the Work Plan. To accomplish this, it is now planned to perform certain tasks concurrently rather than in series as was originally considered by the Work Plan.

Initially, the Work Plan considered that all the sludge must be removed from Ponds 1, 2, and 3 prior to the working surface soils being placed in the ponds. It is now recognized that Pond 1 and/or Pond 2 will be filled with working surface soils prior to the completion of all sludge removal and disposal from Pond 3.

It is the consensus of the designated Project Coordinators and the On-Scene Coordinators that this modification be implemented.

QCF PROJECT COORDINATOR: Kathleen [Signature]

EPA PROJECT COORDINATOR: John R. Meyer

DOE PROJECT COORDINATOR: Michael [Signature]

NORTHWEST ENVIROSERVICE INC.

QUEEN CITY FARMS

WORK PLAN FIELD MODIFICATION FORM

Field Mod. No. 3

Date: 05/06/86

SUBJECT: Borings Start after Pond 2 at NWES Option

DESCRIPTION OF FIELD MODIFICATION: _____

It is desirable to expedite completion of the Remedial Action
authorized by the Work Plan. To accomplish this, it is now
planned to perform certain tasks concurrently rather than in series as
was originally considered by the Work Plan.

Initially, the Work Plan considered that the boring samples would
be initiated after all sludge was out of Ponds 1, 2, and 3 and
the ponds could be done at once. It is now recognized that the
borings will be started after Pond 2 completion or at the Northwest
EnviroService option to expedite the scheduling.

It is the consensus of the designated Project Coordinators and
the On-Scene Coordinators that this modification be implemented.

QCF PROJECT COORDINATOR: _____

EPA PROJECT COORDINATOR: _____

DOE PROJECT COORDINATOR: _____

Karl A. Lisk

John R. Meyer

Michael Huff

NORTHWEST ENVIROSERVICE INC.

QUEEN CITY FARMS

WORK PLAN FIELD MODIFICATION FORM

Field Mod. No. 4

Date: 05/06/86

SUBJECT: Wood Chip Material Transported Off Site

DESCRIPTION OF FIELD MODIFICATION: _____

It is desirable to expedite completion of the Remedial Action authorized by the Work Plan. To accomplish this, it is now planned to perform certain tasks concurrently rather than in series as was originally considered by the Work Plan.

Initially, the Work Plan considered that the wood "chips" in Zone I be chopped and placed in the bottom of the cleaned out ponds prior to working surface placement (Ref. page 7 and 14 - Work Plan). It is now considered to chop this material and transport it off site to a Class I facility.

It is the consensus of the designated Project Coordinators and the On-Scene Coordinators that this modification be implemented.

QCF PROJECT COORDINATOR: [Signature]

EPA PROJECT COORDINATOR: [Signature]

DOE PROJECT COORDINATOR: [Signature]

NORTHWEST ENVIROSERVICE INC.

QUEEN CITY FARMS

WORK PLAN FIELD MODIFICATION FORM

Field Mod. No. 5

Date: 05/06/86

SUBJECT: Monitoring Well Installation As Soon As Possible

DESCRIPTION OF FIELD MODIFICATION: _____

It is desirable to expedite completion of the Remedial Action authorized by the Work Plan. To accomplish this, it is now planned to perform certain tasks concurrently rather than in series as was originally considered by the Work Plan.

Initially, the Work Plan considered that the Monitoring System (page 15) be installed after Pond 3 completion. It is now recognized that the monitoring well installation needs to be started as soon as is practicable prior to Pond 3 completion and possibly prior to the completion of Pond 2. Work can start after the approval of the final design.

It is the consensus of the designated Project Coordinators and the On-Scene Coordinators that this modification be implemented.

QCF PROJECT COORDINATOR: _____

EPA PROJECT COORDINATOR: _____

DOE PROJECT COORDINATOR: _____

[Handwritten signatures]

Michael A. [unclear]

NORTHWEST ENVIROSERVICE INC.

QUEEN CITY FARMS

WORK PLAN FIELD MODIFICATION FORM

Field Mod. No. 6

Date: 05/06/86

SUBJECT: Sequential Cover System Installation

DESCRIPTION OF FIELD MODIFICATION: _____

It is desirable to expedite completion of the Remedial Action
authorized by the Work Plan. To accomplish this, it is now
planned to perform certain tasks concurrently rather than
in series as was originally considered by the Work Plan.

Initially, the Work Plan considered that the Cover System (page 15)
be installed after Pond 3 completion of sludge removal. It is
now recognized that the cover system installation should be
started in a sequenced manner after approval of the Final Design.

It is the consensus of the designated Project Coordinators and
the On-Scene Coordinators that this modification be implemented.

QCF PROJECT COORDINATOR: _____

EPA PROJECT COORDINATOR: _____

DOE PROJECT COORDINATOR: _____

[Handwritten signatures]

NORTHWEST ENVIROSERVICE INC.

QUEEN CITY FARMS

WORK PLAN FIELD MODIFICATION FORM

Field Mod. No. 7

Date: 5/27/86

SUBJECT: Pond #2 and Pond #3 Sampling Plan

DESCRIPTION OF FIELD MODIFICATION: _____

It is desirable to expedite completion of the Remedial Action
authorized by the Work Plan. To accomplish this, it is now
planned to perform certain tasks concurrently rather than
in series as was originally considered by the Work Plan.

It is recognized that the attached sampling plan will be
followed for documentation of all materials from Ponds #2
and #3 if on-site disposal is approved by 6/10/86.

It is the consensus of the designated Project Coordinators and
the On-Scene Coordinators that this modification be implemented.

QCF PROJECT COORDINATOR: 

EPA PROJECT COORDINATOR: _____

DOE PROJECT COORDINATOR: _____

NORTHWEST ENVIROSERVICE INC.

QUEEN CITY FARMS

WORK PLAN FIELD MODIFICATION FORM

Field Mod. No. 8

Date: 5/28/86

SUBJECT: Pond #2 Bottom Stabilization

DESCRIPTION OF FIELD MODIFICATION: _____

It is desirable to expedite completion of the Remedial Action
Authorized Work Plan.

It is recognized to expedite Pond #2 bottom direct removal to a
storage location, stabilization of the Pond #2 bottom will be
done in place by adding kiln dust -- mixing/stabilizing -- and
removal--IF Pond #2 bottom does not go to Pond #3 as the work
plan calls for.

It is the consensus of the designated project c-ordinators and the
on-scene coordinators that this modification be implemented.

QCF PROJECT COORDINATOR: *Scott H. Smith*

EPA PROJECT COORDINATOR: *John R. Wherry*

DOE PROJECT COORDINATOR: *Michael M. Self*

review on 9/10/86 &

RECEIVED

JAN 16 1987

NORTHWEST ENVIROSERVICE INC.

QUEEN CITY FARMS

WORK PLAN FIELD MODIFICATION FORM

HART-CROWSEY & ASSOC., INC.

Field Mod. No. 9

Date: 9/9/86

SUBJECT: Silt Cover Soils

DESCRIPTION OF FIELD MODIFICATION:

It is desirable to expedite completion of the Remedial
Action Authorized Work Plan.

Proposed Specifications Revision: Silt Cover Soils

Please see attached letter for details
and specifications

It is the consensus of the designated project coordinators and the
on-scene coordinators that this modification be implemented.

QCF PROJECT COORDINATOR:

EPA PROJECT COORDINATOR:

DOE PROJECT COORDINATOR:

[Handwritten signatures]
John Meyer
Charles Boaz



HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
206.324.9530

Earth and Environmental Technologies

J-1264-05

September 3, 1986

Northwest EnviroService, Inc.
15800 228th S.E.
Maple Valley, Washington 98038

Attn: Mr. Karl Kinkade

Re: Proposed Specification Revisions - Silt Cover Soils
Queen City Farms
Maple Valley, Washington

Dear Karl:

As previously discussed, we are proposing revisions to the specifications for the Source Control Remedial Action at Queen City Farms. These revisions refer to placement and compaction of the silt cover soils as covered by Sections 2.02A and 2.04C of the specifications. The purpose of this letter is to provide details for a field modification.

Currently, two sources of silt soil are being used and are referred to as the "Kiewit" and "Fiorito" sources. The revisions we propose are detailed below.

- 1) Kiewit Silt - revise specifications to allow in-place dry density (rather than the 100 percent dry density now required), with water contents 5 percent or greater than optimum water content. Soil with water contents 2 to 5 percent over optimum will utilize the original specification.
- 2) Fiorito Silt - Revise specifications to allow the percent of material retained on the U.S. No. 200 sieve to be as great as 55 percent. The specifications currently limit this material to 30 percent retained in the U.S. No. 200 sieve. The Fiorito source occasionally contains material with 40 to 55 percent material retained of the U.S. No. 200 sieve. It is difficult to segregate these materials at the site from those soils passing the criteria and further, it is our opinion that these soils would satisfy design criteria (as discussed below).



Northwest EnviroServices, Inc.
September 3, 1986

J-1264-05
Page 2

- 3) Fiorito Silt - Revise specifications to allow the in-place density of the Fiorito silt with more than 30 percent retained of U.S. No. 200 sieve equal to or greater than 95 percent standard Proctor maximum dry density (rather than the 100 percent dry density now required).

Fiorito silt with 30 percent or less of U.S. No. 200 sieve will require 100 percent of the maximum dry density.

These revisions are based on our experience with similar soils and preliminary testing of these soils. Silt placed in accordance with these revisions will meet the design criteria of silt hydraulic conductivity of 1×10^{-6} centimeters per second or less. Our judgment will be augmented by laboratory hydraulic conductivity tests now in progress. Preliminary results from these tests indicate that these revisions will be effective in providing the design hydraulic conductivity.

We trust this letter meets your needs. Please call if you have questions.

Sincerely,

HART CROWSER, INC.

JAMES H. KLEPPE, P.E.
Senior Project Engineer

MATTHEW G. DALTON
Senior Associate Hydrogeologist

JHK/MGD:ljw

NORTHWEST ENVIRONMENTAL INC.

QUEEN CITY FARMS

WORK PLAN FIELD MODIFICATION FORM

Field Mod. No. 10

Date: November 4, 1986

SUBJECT: Top Soil Cover - 6 inches Sand & Gravel

DESCRIPTION OF FIELD MODIFICATION: _____

It is desirable to expedite completion of the Remedial Action
Authorized Work Plan.

PROPOSED SPECIFICATION REVISION: _____

A six-inch layer of sandy gravel is placed between the uppermost
layer of ^{LH silty gm} sand and gravel and the underlying cobbles. This layer
is intended to limit migration of silt from the upper layer into
the cobbles.

It is the consensus of the designated project coordinators
and the on-scene coordinators that this modification be
implemented.

QCF PROJECT COORDINATOR:  11/4/86

EPA PROJECT COORDINATOR: 

DOE PROJECT COORDINATOR: 

NORTHWEST ENVİROSERVICE INC.

QUEEN CITY FARMS

WORK PLAN FIELD MODIFICATION FORM

Field Mod. No. 11

Date: November 4, 1986

SUBJECT: Rock Rip-Rap - Northwest corner

DESCRIPTION OF FIELD MODIFICATION: _____

It is desirable to expedite completion of the Remedial Action
Authorized Work Plan.

PROPOSED SPECIFICATION REVISION: _____

The 21 inch half culvert is routed into the same rock rip-rap
as the upper diversion drainage system. The rip-rap area has been
enhanced to accommodate both drains. All technical groups have
approved this change.

It is the consensus of the designated project coordinators
and the on-scene coordinators that this modification be
implemented.

QCF PROJECT COORDINATOR: _____

EPA PROJECT COORDINATOR: _____

DOE PROJECT COORDINATOR: _____

[Signature]

11/4/86

[Signature]

[Signature]



HARTCROWSER

Earth and Environmental Technologies

*Final Design Document
Source Control Remedial Action
Queen City Farms, Washington*

*Prepared for
Northwest EnviroServices, Inc.*

J-1264-04

J-1264-04-2.4

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HYDROSEED SUBCONTRACTOR TECHNICAL SPECIFICATIONS

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J-1264-04

FINAL DESIGN DOCUMENT
SOURCE CONTROL REMEDIAL ACTION
QUEEN CITY FARMS, WASHINGTON

INTRODUCTION

This document presents the final design to complete the construction activities associated with the source control remedial action at Queen City Farms, Washington. The final design was prepared in general accordance with the Hart Crowser work plan dated September 27, 1985. This work plan presents a preliminary design which was approved by the Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology).

The objectives of the source control remedial action are to minimize:

- o The potential for contact of surface and ground water with contaminated soils;
- o Migration of contaminants into the environment.

These objectives are to be accomplished by removal of the primary source of contamination (sludge contained in the ponds) and by minimizing future contact of water (precipitation, run-on and groundwater) with underlying contaminated soils. The performance of the system will be assessed based on the presence of water and changes in water levels with time in monitoring wells installed as part of the source control remedial action.

The preliminary and final designs are based on hydrogeologic data which were collected during previous and current work phases.

Hydrogeologic data collected during previous work phases are presented in the following reports.

- o Hart Crowser, Inc., 1983. Assessment of Hydrogeology and Ground Water Quality, Surficial Aquifer, Queen City Farms, King County, Washington, J-1264-01 dated December 13, 1983.
- o Hart Crowser, Inc., 1985. Focused Remedial Investigation, Queen City Farms, King County, Washington, J-1264-01, dated February 7, 1985.

Supplemental data were collected as part of the current work plan as discussed in the following Design Summary section.

Presentation of the final design is presented in the following format:

DESIGN SUMMARY

SCOPE OF CONSTRUCTION

TECHNICAL SPECIFICATIONS

APPENDIX A - FIELD EXPLORATION LOGS

APPENDIX B - GEOMEMBRANE SUBCONTRACTOR TECHNICAL SPECIFICATIONS

APPENDIX C - HYDROSEED SUBCONTRACTOR TECHNICAL SPECIFICATIONS

ATTACHED CONSTRUCTION PLAN DRAWINGS (Sheets 1 through 9)

This document has been prepared in accordance with generally accepted geotechnical and civil engineering practices for the exclusive use of Queen City Farms and their contractor Northwest EnviroServices Inc., and for specific application to the project site and objectives. No other warranty, expressed or implied, is made.

Design Summary

DESIGN SUMMARY

The final design of construction activities related to the Queen City Farms source control remedial action is in general accordance with the objectives of the Hart Crowser Work Plan, dated September 27, 1986, and the consent order signed October 25, 1985. Elements of the final design include an upgradient diversion trench, a final cover, monitoring wells, a silt berm between Queen City Lake and Pond 3, and various surface drainage features.

The final design of the upgradient diversion trench and final cover over the three excavated ponds is based on explorations accomplished prior to and after the consent order. Of particular significance in development of the final design is the depth to, and slope of, low permeability till-like deposits which underlie the ponds and provide an aquitard to downward migration of near-surface groundwater. The locations of the explorations for this project and within the immediate vicinity of the ponds are shown on Sheet 1 of the construction plans. Supplemental design explorations completed as part of the work plan to develop the final design are test pits TP-101 through TP-106 and borings HC-14 through HC-24. As a result of the explorations, contours of the top of the till-like, low permeability very dense, silty SAND and GRAVEL deposits have been prepared and are also shown on Sheet 1. Exploration logs for the supplemental design explorations are included in Appendix A. The logs for the previous explorations are presented in the previous reports discussed above.

Prior to construction of the final design elements discussed in this submittal, sludge contained in the ponds will have been removed. In addition, visually contaminated working surface soils located on the southwest sides of the ponds will have been moved into the depressions created by the sludge removal.

The design of the upgradient diversion trench is based on the collection of the near-surface groundwater (above the till-like soils). Near-surface groundwater flow generally occurs on top of the till-like soil surface. Water level measurements indicate that the groundwater surface varies in

height up to 6 feet above till-like soils in the area of the diversion trench. The diversion trench will be excavated approximately 4 feet vertically into the till-like soils. The trench extends laterally to intercept water which, if not intercepted, would pass beneath the ponds. The hydraulic design of the diversion trench is based on a peak 24-hour rainfall for a 25 year storm. The surface drainage area is about five acres and it is estimated that contributions to groundwater occurs over about 15 acres upslope of the ponds.

The final cover is designed to limit precipitation infiltration and consists of the following layers (beginning with the deepest layer):

- o two feet of compacted clayey SILT
- o a 30 mil PVC geomembrane
- o two feet of sand
- o two feet of cobbles
- o six inches of sand and gravel with a hydroseeded surface.

Precipitation falling on the final cover will be collected by cover drains and generally discharged via an outfall to Queen City Lake. A small amount of collected water will be discharged south of the ponds. Water collected by the upgradient diversion trench will also be discharged into Queen City Lake.

A total of eight monitoring wells will be installed; five of the wells will be within the limits of the final cover. The monitoring wells will be sealed to the geomembrane where they protrude the final cover.

A silt berm will be constructed against the existing berm now separating Pond 3 and Queen City Lake with the intent of limiting seepage from Queen City Lake beneath the final cover. The silt berm will consist of silt layers protected by a sand and gravel shell. The silt will be placed against the side slope of the existing berm and will terminate at the final cover silt. A horizontal layer of silt will also be placed along the toe of the existing berm. Construction of the silt berm requires low Queen

City Lake water levels and may be delayed until after completion of final cover.

Perforated drain pipe will be installed along the eastern toe of the final cover and a ditch (with half culvert) will be constructed along the western edge of the existing gravel road to divert any surface runoff away from the edge of the final cover. Water collected from the toe drain and ditch will be discharged more than 100 feet distance from the final cover. Surface drainage will also be constructed south of final cover. Erosion control measures including rock rip-rap or spalls will be installed at outfall discharge points and along drainage channels. In addition, some drainage channels will be lined with half culverts. All areas graded or disturbed by construction will be hydroseeded with grass.

Greater detail regarding the design of the diversion trench, final cover, monitoring wells, silt berm and surface draining features are given in the technical specifications and plans. The locations of features are shown on Sheets 2 and 3 of the construction plans.

Scope of Construction and Technical Specifications

SCOPE OF CONSTRUCTION

The technical specifications that follow refer to construction activities that will commence once the sludge processing is complete as confirmed by visual observations of the pond bottom. It may be that filling of one pond may commence prior to completion of sludge processing for all ponds. For the purposes of this document, the following construction activities are identified:

- o clearing and grubbing
- o pond filling (preparing grade prior to cover installation)
- o installation of monitoring wells
- o construction of upgradient diversion trench
- o construction of final cover (including cover drains)
- o construction of silt berm (between Pond 3 and Queen City Lake)
- o construction of surface drainage features (including erosion control measures and hydroseeding)

The activities described will primarily be accomplished by Northwest EnviroServices, Inc. (NWES), the manager of construction activities. Hart Crowser, Inc. (Hart Crowser) will assist NWES during these activities by performing on-site observation and quality control testing of earthwork activities, coordination and accomplishment of monitoring well installation, and observation of other activities (e.g., pipe and geomembrane placement). Pool Engineering, Inc. (POOL) will also assist NWES by providing on-site surveying assistance during construction and periodic observation of the drainage systems construction. A subcontractor will be selected by NWES to construct the final cover and place the geotextile/geomembrane sandwich in the upgradient diversion trench. A second subcontractor will be selected to perform the hydroseeding.

The technical specifications are divided into two parts. The following section, TECHNICAL SPECIFICATIONS, describes the overall construction of the diversion trench, final cover, silt berm, surface drainage features, monitoring wells, and site security. Appendices B and C describe the

responsibilities of the subcontractors and will be used in an agreement with the selected subcontractors.

TECHNICAL SPECIFICATIONS

SECTION 1 - SITE PREPARATION

Site preparation includes those activities that will occur prior to excavation or filling at the site such as stripping, clearing, and grubbing. Site preparation also refers to the removal of asphalt pavement and placement of the pavement in the excavated ponds.

1.01 Clearing, Grubbing, and Stripping

- A. Clearing and grubbing shall consist of removal of all trees, brush, or surface debris within the limits of construction area as defined by the upgradient diversion trench, final cover, and silt berm.
- B. All areas shall be stripped of topsoil, grass, and sod.
- C. Material produced during clearing, grubbing, or stripping shall be wasted and will not be allowed for use as fill beneath the pond cover. Off-site disposal shall be in accordance with applicable ordinances and environmental requirements.

1.02 Pavement Stripping

- A. Some or all asphalt pavement areas within the current sludge treatment area will be stripped and placed into excavated ponds. Prior to placement in the pond bottom, the asphalt should be broken into 1- to 2-foot-wide or smaller sections. The placement of asphalt within the ponds is discussed later under Pond Filling, SECTION 2.04(A).

1.03 Existing Utilities

- A. Prior to construction, all underground utilities shall be located and marked.
- B. The power pole in the southeastern corner of the final cover shall be relocated to a new location outside the final cover area.
- C. The airport runway light pole in the southeastern corner of the final cover shall be relocated to a new location that is acceptable for the airport operations.
- D. The existing catch basin that is located in the paved area shall be removed. The existing pipe ends shall be plugged with concrete.

SECTION 2 - EARTHWORK

2.01 Scope

Work covered in this section includes pond filling, preparation of final cover subgrade, construction of the final cover and silt berm, excavation of trench, and placement of pipeline bedding and backfill.

2.02 Earth Materials

Requirements and definitions for earth materials to be used are given below.

A. Silt

Silt will be used in the final cover, silt berm, and anchor trench at the upgradient diversion trench. The silt should be a natural clayey silt or silty clay containing no more than 30 percent particles (by dry weight) retained on the U.S. No. 200 sieve. The silt plasticity index (as determined by Atterberg limits tests) shall be no less than 4. No particle

greater than 3 inches shall be allowed in the silt. The silt shall be free of organics, debris, or other deleterious material.

B. Sand

Sand will be used above the geomembrane as drainage and protection from construction equipment. The sand should contain no more than 5 percent retained on the U.S. No. 4 sieve and no more than 5 percent passing the U.S. No. 200 sieve. No particle should be greater than 1/4-inch in size.

The sand shall be well-graded and contain at least 10 percent of its weight in each sand size (coarse, medium, and fine) as defined by Unified Soil Classification System and ASTM Method D 2487. The sand shall be free of deleterious material such as wood debris and organics.

C. Sand and Gravel

The sand and gravel will be used in the final cover above the cobble layer to support grass cover and in the silt berm. The sand and gravel may also be used as backfill in the diversion trench where noted on the plans. The sand and gravel shall be free of wood debris, organics, or other deleterious material, and shall satisfy the following gradation.

<u>Particle or Sieve Size</u>	<u>Percent Passing by Dry Weight</u>
3-inch	100
3/4-inch	50 - 85
#4	35 - 50
#200	5 - 12

D. Cobbles

A layer of cobbles will be used to deter burrowing animal activity. The cobbles shall be free of wood debris, organics, or other deleterious material and satisfy the following gradation.

<u>Description</u>	<u>Particle Size in Inches</u>
Maximum size	12
Minimum size	3
Average size	6

E. Pea Gravel

Pea Gravel will be used for pipe bedding and backfill in the upgradient diversion trench where noted on the plans. Pea gravel shall be a clean mixture free of wood debris, organics and other deleterious materials, and shall conform to the following gradation when tested in accordance with ASTM D 422.

<u>Particle or Sieve Size</u>	<u>Percent Passing by Dry Weight</u>
3/4-inch	100
3/8-inch	95 - 100
#8	0 - 10
#200	0 - 3

F. Imported Pond Fill

In the event it is necessary to import fill to meet proposed subgrades at the ponds, the imported fill shall consist of a well-graded sand or sand and gravel, be free of deleterious material, and contain no more than 12 percent by dry weight of material passing U.S. No. 200 sieve. The maximum size of any particle shall be 3 inches.

G. Native Soil

A portion of the soils to be encountered in the excavation for the diversion trench may be suitable for sand and gravel as used in the final cover or in filling the ponds. NWES could segregate materials that are suitable and provide temporary storage on-site.

Clay, silt, or till-like soils are not considered suitable for construction. Those soils that are suitable should correspond to the gradation given previously for Imported Pond Fill or Sand and Gravel depending on the use of the native soil.

2.03 Other Materials

The selection of various materials will be reviewed (as indicated) prior to their use.

A. Geomembrane

The geomembrane shall be unreinforced PVC with a minimum thickness of 30 mils. Plasticizers that are to be used in the manufacture of the PVC shall be selected with this specific project in mind. Quality control and quality assurance for the geomembrane materials and the construction of the geomembrane will largely be the responsibility of the subcontractor (see Appendix B) with review and observation by NWES and Hart Crowser. A portion of those subcontractor QA/QC responsibilities will address the quality of the PVC sheets as they are manufactured. NWES and Hart Crowser will review the selection of the PVC geomembrane and the supporting QA/QC data prior to installation at the site. NWES will approve data submittals prior to installation.

B. Cushion Geotextile

The cushion geotextile is intended to protect the geomembrane when placed in the diversion trench. The cushion geotextile is placed above and below the geomembrane (see Typical Section M-M on Sheet 7). The cushion geotextile shall be a non-woven, needle punched polyester fabric weighing no less than 10 ounces per square yard. Edges of geotextile shall overlap a minimum of 12 inches. No tears, holes, or other defects shall be allowed on as-placed geotextiles. The selected cushion geotextile shall be reviewed by Hart Crowser prior to installation in terms of its intended use in this project.

C. Filtering Geotextile

The filtering geotextile is placed over the vertical section of the diversion trench to limit the passage of fines into the trench and the relatively permeable backfill (refer to Typical Section M-M on Sheet 7). The filtering geotextile shall be a woven monofilament polypropylene fabric. The filtering geotextile shall also have a minimum percent open area of 4 percent and an equivalent opening size represented by no larger than a U.S. No. 40 sieve and no smaller than a U.S. No. 70 sieve. The selected filtering geotextile shall be reviewed prior to installation by Hart Crowser in terms of its intended use in this project. Edges of geotextile sheets shall overlap a minimum of 12 inches.

2.04 Execution

A. Pond Filling

The excavated ponds will be filled with stripped asphalt pavement, visually contaminated working surface soils (removed from southwest of the ponds), and other granular fill. Requirements for the size of pavement pieces were given earlier (Section 1.02). The pieces of pavement shall be placed at the bottom of the ponds and shall be placed to minimize creation of voids. Pieces of pavement shall be scattered within contaminated soil or granular fill. Material placed in the ponds shall be compacted by heavy equipment traffic or compactors to yield a firm non-yielding surface. Placement of these materials shall be in loose lifts not to exceed 24 inches. Equipment used for compaction shall weigh between 5 to 20 tons.

Granular fill to complete grading of the ponds may include the following (previously described in Section 2.02) materials: Sand, Sand and Gravel, Native Soil Backfill, or Imported Pond Fill. No excessively organic or compressible soils will be allowed in the pond filling.

B. Preparation of Subgrades (Prior to Silt Placement)

Prior to silt cover layer placement, the surface of the pond fill shall be completed to the grades indicated on Sheet 3. The final surface shall be proof-rolled with a heavy compaction roller to identify loose or soft areas. Loose or soft areas may require additional compaction or over-excavation and replacement or both to produce a firm, non-yielding surface. The accomplishment of a firm surface will be based on visual observation during equipment traffic. Equipment used for compaction shall weigh between 5 to 20 tons.

Final preparation of the subgrade may be delayed until completion of geomembrane placement and backfill in the diversion trench. This delay may be necessary to facilitate equipment access to the diversion trench.

C. Silt Cover Placement

A minimum of 2 feet of clayey silt will be placed on the "pond-filling" subgrade. The silt shall be placed in 8-inch loose lifts and compacted to 100 percent of maximum dry density as determined by the standard Proctor method (ASTM D 698). The compacted water content of the silt shall be at least 2 percent greater than optimum water content (as defined at the standard Proctor maximum dry density). Testing of the degree of compaction and water content will be accomplished by Hart Crowser (see Section 4.00). The necessity of modifying the natural water content will depend on storage conditions, weather conditions, and original water content at the borrow source.

The final surface of the silt shall be smooth and free from protrusions (gravel, etc.) greater than 1/4-inch-high. The final surface of the silt will be observed by the geomembrane subcontractor and deemed acceptable by him for installation of the geomembrane.

The silt cover layer shall extend into the excavation for the diversion trench as shown on the plans.

D. Geomembrane Placement (Final Cover and Diversion Trench)

The PVC geomembrane will be placed directly on the completed silt cover layer. The geomembrane will also extend into the diversion trench where it will be underlain and overlain by a cushioning geotextile. The geomembrane installation must be coordinated with the completion of the trench excavation. The edges of the geomembrane will be "anchored" in a 12-inch-wide by 12-inch-deep trench that is machine- or hand-excavated into till-like soils and clayey SILT cover.

The edges of all geomembranes shall be overlapped a minimum of 2 inches and seamed.

Field seams shall be constructed so that the seamed areas have the same or greater tensile strength and peel resistance as the factory seams. All seams shall have a tensile strength equal to or greater than 80 percent of the tensile strength of individual sheets. The integrity of each section of seam shall be checked in the field (see Section 6.00 for QA/QC program). In addition, the areas between seams shall be visually examined by the subcontractor during and after the geomembrane installation. The geomembrane subcontractor is fully responsible for installing a geomembrane free of incomplete seams, holes, rip, tears, or other defects that would allow leakage of collected water.

No wrinkles or "fish mouths" shall be allowed at seams. If wrinkles or fish mouths occur, they shall be removed and replaced with a PVC patch.

The geomembrane shall also be sealed to a protective PVC 8-inch-diameter casing at the monitoring wells. The casing will be in place prior to geomembrane installation. The sealing of the geomembrane to the casing shall be accomplished with a PVC "boot". All seams necessary for this boot shall be tested in accordance with Section 6.00.

E. Placement of Final Cover Soil Layers (Excluding Silt)

Final cover soil layers excluding silt include 2 feet of sand, 2 feet of cobbles, and 6 inches of sand and gravel. In some margins of the final cover, native soils (or import fill) may be required to reach grade prior to sand and gravel layer grade. The geomembrane subcontractor will be responsible for construction of final cover soil layers (all of which are above the geomembrane).

The placement of the sand will be directly on the geomembrane. It is the responsibility of the subcontractor to place the sand without damaging the geomembrane. The subcontractor is also responsible for incorporating drainage features within the final cover as indicated in the plans.

Placement of subsequent soil layers (cobbles, native soil, and sand and gravel) shall also be accomplished without damaging the geomembrane. While no requisite density or degree of compaction is required for soil layers above the geomembrane, each layer shall be densified to a firm condition using equipment traffic or other available means.

F. Excavation of Upgradient Diversion Trench

The excavation of the diversion trench shall be in accordance with Typical Sections K-K and M-M shown on Sheet 7. The excavation of the trench into the till-like soils shall be limited to 4 feet vertically in order to satisfy WISHA safety requirements. The excavations into the till-like soils will be a minimum of 4 feet and generally average 5 feet into the till-like soils. When a depth greater than 4 feet is necessary, the till-like soils will be excavated with the side slopes shown on the typical section. Silt and till-like soils shall not be used as on-site fill; however, relatively clean, sand and gravel (see Native Soil Backfill description) may be used as on-site fill. It may be desirable to segregate and stockpile useful soils during the excavation process.

It is anticipated that groundwater seepage will be encountered during the excavation. The seepage shall be controlled so that no water reaches the vertical portion of the trench. Seepage control can simply be sand bags or soil berms that channel the water "down" the excavation along the bench. No temporary trench shall be cut in the bench to channel the water.

G. Placement of Bedding and Backfill in Diversion Trench

Pea gravel bedding material shall be placed in the trench and leveled to provide a foundation for the perforated PVC pipe. The pipe shall be placed in accordance with the manufacturers instructions directly on the bedding with minor excavations needed for the bells.

Pea gravel bedding shall be placed around and over the pipe to 6 inches above the pipe. The pea gravel shall be manually tamped and worked around the pipe in a manner that protects the geomembrane and prevents disturbance of the pipe alignment.

Pea gravel backfill shall then be placed in approximately 12-inch-high lifts up to the top of the vertical trench section. Each lift shall be lightly tamped with a small, manually operated vibratory plate compactor.

Typical trench sections for the diversion pipeline are shown on Sheet 7.

Due to excavations necessary for the diversion trench and limited equipment access, it may be desirable to construct the diversion trench and final cover in stages. For example, once the diversion trench excavation is complete and the geomembrane is installed in the trench, the pipe and backfill will be installed. However, the best access for pipe placement and backfilling is from the pond side prior to final subgrade filling and final cover placement. It should be noted that for this construction scheme the geomembrane edges must be protected.

A silt dam (not silt berm) will be constructed at the downstream end of the diversion trench that will in conjunction with the geomembrane terminate

the flow of water in the trench. In this manner, water entering the trench will flow into the perforated PVC pipe and outfall pipe and eventually be discharged into Queen City Lake. The silt dam should be compacted in layers in accordance with compaction requirements given for the silt cover layer. The silt dam must be constructed prior to geomembrane placement in the trench.

H. Pipe Bedding and Backfill for Cover Drains and Toe Drains

The corrugated perforated polyethylene tubing shall be laid in a straight alignment on top of 2 inches of sand which has been placed on the geomembrane or silt materials. As additional lifts of sand are placed, the sand shall be hand tamped around the tubing and then lightly compacted with a small vibratory plate compactor so as to not disturb the pipe alignment. Equipment shall avoid running over the pipe until a minimum of 12 inches of sand has been placed over the pipe.

I. Pipe Bedding and Backfill for Outfalls

The construction of the upgradient diversion outfall pipe will begin at the silt dam and continue to Queen City Lake. The trench, bedding, and backfill details are shown on Sheet 8.

The construction of the west toe drain outfall pipe will begin at Catch Basin No. 2 and continue to Queen City Lake. The trench bedding and backfill will be the same as shown in the Typical Detail on Sheet 8, except bedding and backfill materials shall be silt where the pipeline goes through the silt berm.

The trench, bedding, and backfill for the corrugated metal pipe draining from Catch Basin No. 1 shall be the same as shown in the Typical Detail on Sheet 8.

Trenching, bedding, and backfill for these three pipelines shall conform to the Plans and Specifications herein, and to sections 7-04 and 7-05 of the 1984 APWA Standard Specifications.

J. Silt Berm

The configuration of the silt berm is shown on Typical Section N-N on Sheet 7. As Queen City Lake recedes, the lower water level will allow construction of the silt berm. No construction of the silt berm shall occur until the water level has fully receded from this area. The lake level may delay construction of the silt berm but shall not affect construction of the cover.

The silt in the silt berm shall be compacted to the requirements given earlier for the silt cover layer in terms of loose lift thickness, water content, and minimum dry density. No compaction of silt shall occur in wet areas or standing water. The sand and gravel in the silt berm shall be compacted to dry density equal to or greater than 95 percent of the maximum dry density as determined by the standard Proctor method. The sand and gravel shall conform to the gradation given earlier and shall be placed in loose lifts not to exceed 10 inches.

The existing ground beneath the silt berm shall be prepared in accordance with recommendations given earlier for clearing, grubbing, and stripping. After stripping, the subgrade shall be proof-rolled with heavy compaction equipment to identify loose or soft areas. Such loose or soft areas shall be compacted or overexcavated and replaced with compacted silt or sand and gravel, depending on the nature of the material to be placed directly above. The size of compaction equipment shall be as given in Section 2.04(A).

The cover drain outfall will be constructed over the downslope face of the silt berm. The outfall will consist of catch basins, PVC pipe, and rip-rap as shown on Sheet 2. Erosion protection shall be provided at the outfall as shown on Sheets 2 and 7.

SECTION 3 - DRAINAGE

3.01 Scope

Work covered in this section includes the installation of pipelines, manholes, inlets, and catch basins for the upgradient diversion system, outfalls, toe drains, and culverts.

3.02 Drainage Materials

A. Polyvinyl Chloride Pipe (DR 18)

A short section of 12-inch-diameter DR 18 PVC pipe is used from the silt dam to manhole No. 1 at the outlet of the diversion trace.

The PVC pipe shall conform to the requirements of AWWA C900 pressure class 150 and shall have the same outside dimensions as ductile iron water pipe. Pipe joint shall conform to ASTM D 3139 using a restrained rubber gasket conforming to ASTM 3477. The pipe shall be Johns Manville Blue-Brute.

B. Perforated Polyvinyl Chloride Pipe (DR 18)

Perforated 12-inch-diameter DR 18 PVC pipe is used to collect and convey water in the upgradient diversion trench. Perforated PVC pipe (DR 18) shall be PVC pipe (DR 18) with perforations drilled through the pipe walls as shown on Sheet 8.

A short section of 6-inch-diameter perforated DR 18 PVC pipe is used between the cleanout and Manhole No. 3.

This grade of pipe is not provided with perforations; the pipe shall be modified by NWES or a selected machine shop.

C. Polyvinyl Chloride Pipe (SDR 35)

The diversion trench outfall will use 12-inch-diameter SDR 35 PVC pipe. PVC pipe (SDR 35) shall be PVC sewer pipe conforming to the requirements of ASTM D 3034, SDR 35, or ASTM F 789. Joints shall conform to the requirements of ASTM D 3212 using restrained rubber gaskets conforming to ASTM F 477. Fittings shall be injection molded tees. Solvent cemented fittings will not be allowed.

The West Toe Drain System and outfall from the Grate Inlet will use 8-inch-diameter SDR 35 PVC. Requirements shall be as for the 12-inch-diameter SDR 35 PVC pipe.

D. Corrugated Perforated Polyethylene Tubing

Six-inch- and eight-inch-diameter perforated corrugated polyethylene tubing are used for the cover drains and the East Toe Drain System. The pipe shall be Advance Drainage Systems (ADS) heavy duty tubing. The ADS tubing shall be provided with a polyester knitted fabric (or "sock"). This sock is available with the pipe and is not the same fabric as discussed later for perforated PVC pipe. Cleanouts to the perforated tubing will be provided as shown on the plans (see sheet 9).

E. Corrugated Aluminum Drain Pipe

Solid, 12-inch-diameter corrugated aluminum drain pipe is used for surface water conveyance beneath the gravel road and shall meet the requirements of AASHTO M 196. Coupling bands can be used and shall meet the requirements of the APWA 1984 Standard Specifications, Section 9-05.1(3)A and 9-05.5(5).

F. Ductile Iron Pipe Fittings

Ductile iron pipe fittings used at the cleanout elbows shall be ductile iron or class 250 gray iron conforming to AWWA C110 and C111 and shall be

cement mortar lined according to AWWA C104. Plain end fittings shall be used for PVC pipe (DR 18).

G. Outdoor Cleanout

The outdoor cleanout for the 6-inch upgradient diversion system pipe shall be heavy duty cast iron with gasket seal-bronze plug, J.A. Smith 4251.

H. Transition Coupling

The transition coupling for the cleanout shall be a ROMAC style 501 with gaskets sized for 6-inch PVC pipe (DR 18) and the spigot outlet on the cleanout.

I. Manholes

Three manholes are required for upgradient diversion trench system. The manholes shall be 48-inch-diameter precast concrete with eccentric cones conforming to requirements of ASTM C 478. Joints shall be rubber gasketed in accordance with ASTM C 443. Base sections shall be precast cored drilled to receive the pipes, and supplied with KOR-N-SEAL boots with stainless steel bands.

Manhole steps shall be constructed of 1-inch-diameter deformed steel bar conforming to ASTM A 615, intermediate or standard grade, hot bent and galvanized after bending. Galvanizing shall conform to ASTM A 123. Steps shall be safety-type with the step rung at least 3 inches below the legs. Straight pattern steps will not be accepted.

Manhole base sections of three feet or greater in height shall be provided with a ladder made of steel galvanized after fabrication, conforming to the requirements for steps given in Section 9-12.2(3). Base sections less than 3 feet in height require no steps or ladder.

The manholes with accessories shall be Associated Sand and Gravel or equal.

The cast iron frame and 24-inch-diameter cover shall have the word DRAIN cast into the top surface of the cover with 2-inch-high letters, a 1-inch-diameter lifting hole in the cover and shall be Olympic Foundry MH 30 or equal.

Castings shall be made of cast iron ASTM A 48 Class 30, cast steel, ASTM A 27, Grade 70-36, or modular iron, ASTM A 339, Grade 60-45-10 at the manufacturer's option, and shall be free of porosity, shrink cavities, cold shuts, cracks, or any surface defects which would impair serviceability. Repair of defects by welding, or by the use of "smooth-on" or other repair material will not be permitted.

J. Catch Basins and Grate Inlet

Three catch basins are used outside the perimeter of the cover for surface drainage. The catch basins shall be precast concrete Grate Inlets Type 2 with one or two piece base sections in accordance with Washington State Department of Transportation Standard Plan B-4c. The bottom of the catch basins shall extend 18 inches minimum below the bottom of the pipe. The Standard Plan B-4c is given on Figure 1 of this document.

The Grate Inlet is used for the final cover drains and shall consist of only the top half of a two piece catch basin base section. The concrete base shall be constructed in the field with the bottom slightly below the bottom of the pipe.

Steel grates and frames shall be hot-dipped galvanized and conform to the requirements of 1984 APWA Standard Specifications, Section 9-05.16.

K. Nonshrink Grout

Nonshrink grout is used at the grate inlet and shall be Embeco 167 mortar manufactured by Master Builders Division of Martin Marietta Corporation. The grout shall be mixed as required by the manufacturer to produce a

material that can be readily packed into place and that will bond to adjacent surface.

L. Grout

Grout is used along the bottom of the manholes and shall be composed of the materials in the following proportions:

Portland cement (ASTM C 150, Type 1) - 1 part by volume

Hydrated Lime (Type S) - 1/2 part by volume

Manufactured Sand - not less than 2-1/4 and not more than 3 times the sum of the volumes of cement and lime

Water - sufficient to form a workable mix which can be easily spread and will readily adhere to masonry surface

M. Concrete

Concrete in quantities smaller than one cubic yard shall be made from commercially available 60 pound sacks of premixed sand, gravel, and cement. Such concrete is used around monitoring well protective casing and the grate inlet bottom.

N. Geotextile Sock for Upgradient Diversion System

The geotextile sock for the perforated PVC pipe (DR 18) shall be fitted around each pipe prior to placement in the trench. The geotextile sock is intended to prevent trench backfill from entering the pipe via the perforations. The geotextile shall be the same material utilized for the filtering geotextile. The sock or wrap shall be firmly attached to the pipe prior to installation to avoid getting soil between the geotextile and pipe. The sock shall cover all perforations but need not cover the bell end of the pipe. The geotextile should extend a minimum of 3 inches beyond

the last perforation. Overlaps between geotextile edges shall be at least 6 inches.

O. Corrugated Half Culvert

Corrugated half culverts (18-inch and 21-inch-diameter) will be utilized along drainage ditches at the east toe drain system (at the road), at the upgradient diversion system, and above the cover drain (see Sheet 2 of the plans). The corrugated half culvert shall be 16 gage aluminized steel with annular corrugations. The culvert shall be supplied in 20-foot-lengths made from 2-foot sections riveted together. The end sections shall be matched punched for field joining and shall be supplied with bolts and nuts. The culvert shall be supplied with anchor stakes and half round bands for anchoring every 100 feet.

P. Animal Barrier Screen

Animal barrier screens shall be attached to outlets of selected pipes as shown in the plans. The screen shall be constructed of stainless steel mesh with $\frac{1}{2}$ -inch openings. The individual wire size shall be selected to limit destructive gnawing of the wire by animals. The animal barrier screen is shown at selected locations of pipes on the plans and is designated as "screen".

3.03 Execution

A. Perforated Piping

The perforated piping for the upgradient diversion system, the cover drain system, and the east toe drain system shall be installed in accordance with the plans and specifications herein and the manufacturers instructions.

The perforated PVC pipe (DR 18) shall be laid with bells upstream and with perforations rotated so two rows of perforations are turned down as shown on Sheet 8.

All pipe shall be in reasonably close conformity with the line and grades shown in the Plans. All pipe shall be open, clean, and free draining.

B. Non-Perforated Piping

All non-perforated piping shall be installed in accordance with the manufacturers instructions, sections 7-04 and 7-02 of the 1984 APWA Standard Specifications for storm sewers and culverts, and the details shown on the plans.

C. Manholes, Catch Basins, and Grade Inlets

Manholes, catch basins, and grade inlets shall be installed in accordance with the details shown on the Plans and Section 7-05 of the 1984 APWA Standard Specifications.

SECTION 4 - EROSION CONTROL AND HYDROSEEDING

4.01 Scope

Work covered in this section includes the installation of rock rip-rap blanket, and rock spall blanket at locations shown on the Plans; preparation of the project site for hydroseeding; and protection of the hydroseeded areas until the grass is established.

4.02 Erosion Control Materials

A. Hydroseed

The prepared surface for hydroseeding shall be either sand and gravel or existing soils as previously described in Section 2. Selected hydroseed shall be shallow-rooted when placed on the final cover to limit root penetration to the geomembrane. Hydroseed placed elsewhere can be selected at the discretion of the hydroseed subcontractor.

B. Rock Rip-rap Blanket

The rock rip-rap blanket shall consist of hand placed rip-rap of which 60 percent of the stones shall weigh about 150 pounds (see Section 9-13.2 of 1984 APWA Standard Specifications).

C. Rock Spall Blanket

The rock spall blanket shall consist of angular to sub-angular, 3-inch to 12-inch rock spalls of hard, sound stones free of seams, cracks, or other defects.

4.03 Execution

A. Rock Rip-rap Blanket

The rock rip-rap blanket shall be constructed at the trench and cover drain outfall as shown on Sheet 2. The rip-rap shall be constructed at the locations shown on the Plans in accordance with sections 8-15.3(1), 8-15.3(3) of the 1984 APWA Standard Specifications.

B. Rock Spall Blanket

The rock spall blanket shall be constructed at locations of surface drainage channels shown on Sheet 2. The thickness of the spalls shall be no less than 12 inches.

C. Hydroseeding

Areas to be hydroseeded include the final cover surface and all excavations and filled areas.

Hydroseeding shall be applied from August 15 to September 15, 1986 or from March 1 to May 15, 1987 or otherwise in accordance with Section 8-01.3(7) of 1984 APWA Standard Specifications.

Jute matting shall be placed on all slopes steeper than 30 percent or as otherwise directed by the Engineer prior to hydroseeding.

Clear plastic covering shall be placed on hydroseeded slopes as required to control erosion as determined by Northwest EnviroServices, Inc.

Placement of jute matting and clear plastic covering shall be in accordance with section 8-01.3(8) of 1984 APWA Standard Specifications.

Northwest EnviroServices, Inc. shall protect seeded areas from damage by vehicle and pedestrian traffic and excessive erosion, shall provide any water necessary for irrigation and shall mow the grass in accordance with section 8-01.3(11) of 1984 APWA Standard Specifications.

SECTION 5 - MONITORING WELLS

To assess the performance of the source control remedial action, a monitoring system will be installed. The system will consist of eight wells located as shown on Sheet 2. Seven new wells will be installed. An existing well (HC-1) will be incorporated into the monitoring system. Due to possible construction disturbance, well HC-1 will be relocated. As shown on Figure 2, the wells are located to monitor water levels above the low permeability (till-like) units both upgradient and downgradient of the ponds.

The wells will be generally constructed as shown on Figure 2. They will consist of 2-inch-diameter stainless steel screen and riser pipe, sand pack, grout seal, and protective covering for the well head. Five of the wells will protrude through the final cover system. Sealing of the wells will be accomplished as described in Section 2.04(D). The well risers will be protected by oversized PVC pipe that extends several feet above the final cover elevation. As the geomembrane is placed, it will be sealed with the outer PVC pipe around the wells, as per manufacturer directions.

The monitoring wells will be installed, using a hollow-stem auger or ODEX drilling system, before the cover system is started. Soil sampling will be conducted once the fill materials have been drilled through on 2.5-foot intervals to assess the geologic conditions at each specific monitoring location. Drilling will proceed until at least 5 feet of till-like soil is encountered or until a depth of 75 feet is reached. If till-like soil is not encountered at a specific monitoring location the boring will be abandoned (grouted) and a new location approximately 20 feet upslope will be selected for drilling.

The depth intervals to place well screens will be selected based on the geologic log prepared during drilling. Each boring will be screened such that the screen extends at least 6 inches below the contact defining the low permeability and overlying higher permeability strata. Prior to setting the screen the boring below the bottom of the selected screened interval will be grouted.

If both silt and till-like soil are encountered at a location and the two strata are separated by higher permeability strata, the initial well will be installed to monitor at the top of the lower low-permeability unit. A second boring will be drilled within 10 feet of the initial boring and will be screened at the top of the higher elevation low-permeability unit.

The wells will be installed by telescoping the screen and riser pipe through the auger center, placing the sand pack around the screen, and placing the bentonite slurry seal. A concrete surface seal will be installed to anchor the 2-inch-diameter riser pipe and 8-inch-diameter protective casing.

SECTION 6 - CONSTRUCTION QUALITY CONTROL/QUALITY ASSURANCE PROGRAM

6.01 General

Quality control and quality assurance procedures shall be accomplished to determine that materials and workmanship are in general accordance with construction plans and specifications.

6.02 Responsibilities of NWES

A representative of NWES will act as the project quality assurance/quality control individual. That representative will be responsible for accomplishment of the required testing, observations, and reports. All reports of QA/QC work shall be directed to NWES for their review.

6.03 Responsibilities of Hart Crowser

A representative of Hart Crowser will assist NWES by accomplishing:

- o Periodic observations and documentation of fill placement in ponds.
- o Observation and documentation of excavation of diversion trench.
- o Index testing of sand, sand and gravel, imported pond fill and native soil backfill that shall include grain size analysis testing (ASTM D 422).
- o Index testing of silt soils to be used as cover that will include moisture content (ASTM D 2216), grain size analysis (ASTM D 422), and Atterberg limits (ASTM D 423 and 424). Laboratory compaction testing of silt soils will also be accomplished (ASTM D 698).
- o Observation and documentation of placement of silt cover layers including field compaction testing. The field compaction testing will be accomplished on each lift. The frequency of tests will partly be a

function of material variability and test result consistency and will be determined during construction.

- o Observation and documentation of diversion trench construction.
- o Observation and documentation of cover construction including geomembrane installation.
- o Review the selection of other construction materials such as geotextiles and geomembrane.
- o Review procedures and results of geomembrane subcontractor quality assurance/quality control program.
- o Provide daily field reports summarizing the construction activities and conditions observed during each site visit, as well as any recommendations made or tests performed.
- o Observe and document installation of monitoring wells.

6.04 Responsibilities of Pool Engineering

Representatives of Pool Engineering will assist NWES by accomplishing the following:

- o Review of pipe, manholes, catch basins, inlets, rip-rap, hydroseed, and other materials to be ordered for the requirements stated in the specifications.
- o Surveying Ponds After Excavation:
The three ponds will be surveyed to determine the horizontal and vertical limits of excavation. A sketch of the excavated ponds will be prepared.

- o Grade Staking and Field Adjustment of Facilities:

A survey crew will stake the Upgradient Diversion System and the Cover Drain System, and will provide grade sheets to NWES. Engineering and surveying support will be provided to NWES to adjust drainage system grades to fit field conditions discovered during excavation of trenches.

- o Grade Staking for Subgrade:

A survey crew will set grade stakes for the subgrade and provide grade sheets to NWES.

- o Engineering Observations:

A representative of Pool knowledgeable in construction of drainage systems will provide periodic observation of the work at key times to advise NWES on construction methods and procedures.

- o As-Built Drawings:

After construction is complete, a survey crew will determine locations of surface features, elevation at manholes, catch basins, and inlets, and ground surface elevations of the Final Cover. The construction plans will be revised to show the "As-Built" conditions. A reproducible mylar of the As-Built drawings will be supplied to NWES.

6.05 Responsibilities of Geomembrane Subcontractor

The geomembrane subcontractor is required to accomplish the following quality assurance/quality control tasks (greater detail is given in Appendix B).

- o Factory testing of sheet material properties. The properties shall meet or exceed those given in National Sanitation Foundation (NSF) Standard 54.
- o Factory testing of factory seam properties. The properties of factory seams shall meet or exceed those given in NSF Standard 54.

- o Submittal of factory test results to NWES prior to use of material on site (including documentation of geomembrane composition, e.g. plasticizer).
- o Creation and destructive testing of daily test seams. Such seams shall be representative of production seams that day and will be tested in peel adhesion and bonded seam strength. Field seams shall meet or exceed requirements for factory seams.
- o Non-destructive integrity testing of field production seams using vacuum box, air lance or other agreed upon methods. The entire length of all field seams will be tested.
- o The excavation of a completed section of the final cover to observe the condition of the geomembrane subsequent to placement of overlying soil cover layers.
- o Daily records of field QA/QC testing and geomembrane installation (including seaming).
- o Thickness of final soil cover layers (excluding silt) and placement of these soils without damage to geomembrane.

SECTION 7 - SITE SECURITY

Protection of the constructed facilities will be provided by construction of a chain-link fence around the site. The fence shall be sufficiently high and constructed to deter vandalism and trespassing. The fence shall be located so that the upgradient diversion system and final cover are inside a fenced area. A separate short section of fence will be necessary on the east side of the gravel road to envelope the section of the upgradient diversion trench at that location.


Monitoring wells outside the fenced area will be provided with locking protective caps.

Signs will be posted prohibiting excavation within or adjacent to fenced areas and within roadway at intersection with the upgradient diversion trench.

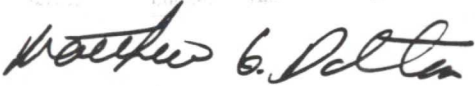
HART CROWSER, INC.

JAMES H. KLEPPE, P.E.
Project Engineer




GARRY E. HORVITZ, P.E.
Senior Associate Engineer

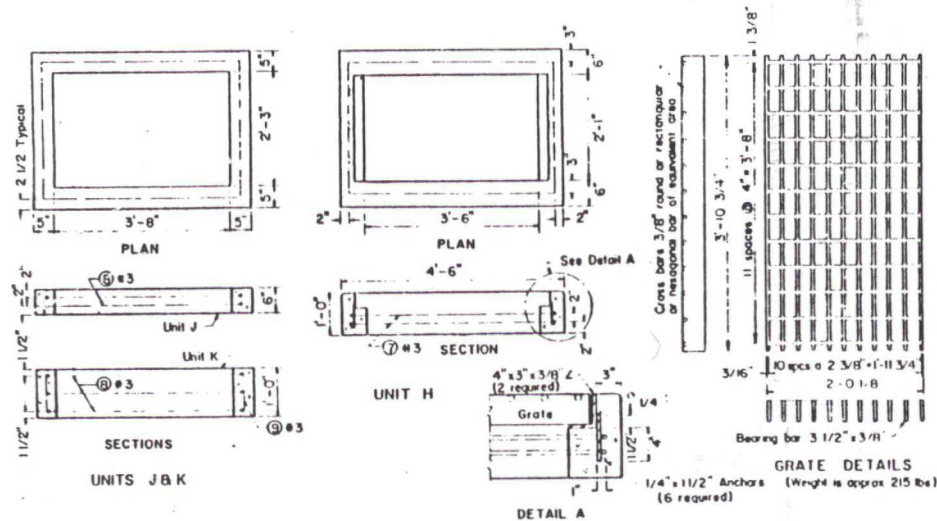




MATTHEW G. DALTON
Senior Associate Hydrogeologist

JHK/GEH/MGD:sea

Catch Basin and Grate Inlet Standard



BAR LIST					(All dimensions are out to out)	
MARK	LOCATION	NO	SIZE	LENGTH	BENDING DIAGRAM	
1	Bottom slab & side wall	3	5'-9"			
2	Bottom slab & side wall	2	12'-5"			
3	Bottom slab & side wall	2	7'-2"			
4	Bottom slab & side wall	2	2'-9"	Str		
5	Wall	4	9'-1"	Hoop		
6	Side wall	3	14'-6"	Hoop		
7	Unit H	2	14'-2"	Hoop		
8	Unit J	2	14'-2"	Hoop		
9	Unit K	4	0'-9"	Str		
10	Side wall	8	2'-8"	Str		
11	Bottom slab & side wall	4	7'-5"			
12	Bottom slab & side wall	3	6'-0"			
13	Side wall	4	14'-6"	Hoop		

NOTES

Angles shall be set so that each bearing bar or prefabricated grate shall have full bearing on both ends. The finished top of concrete shall be even with the grate surface.

Top of inlet grate shall be placed at ground level to present an unobstructed ditch or median section.

All exposed concrete edges shall be finished with a one-half inch radius edger tool.

Pipes may enter through the knockouts on any side at any reasonable angle, provided the outside of the pipe can be contained between two opposite walls.

The flow line of the outlet pipe shall be 1'-6" minimum above the inside bottom of the inlet structure.

The grade line of the top inside of any inlet pipe shall enter at a point no lower than the grade line of the top inside of the outlet pipe.

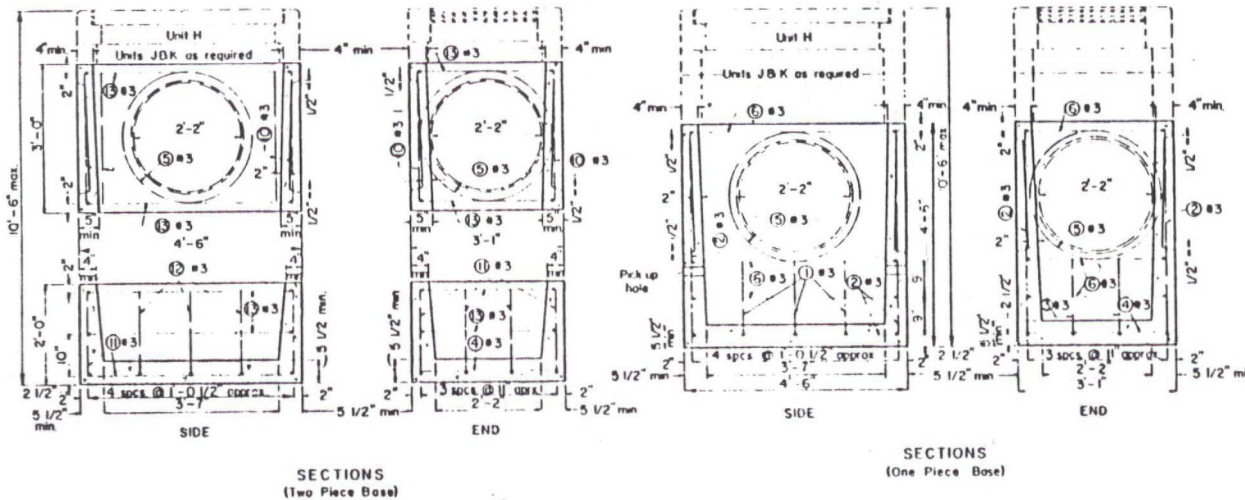
Unit H and optional extension units J and K shall be grouted in place to the satisfaction of the Engineer.

All pickup holes shall be grouted full after the basin has been placed.

Base units may be either precast or cast-in-place.

All reinforced cast-in-place concrete shall be Class A. All precast concrete shall be Class AX.

Reinforcing steel shall be Grade 40 or Grade 60.



GRATE INLET TYPE 2

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

DESIGNED BY: WASHINGTON

IN A BUREAU, DEPARTMENT

DESIGNED BY: WASHINGTON

DESIGNED BY: WASHINGTON

DESIGNED BY: WASHINGTON

DESIGNED BY: WASHINGTON

1.25.80	Added note on rebar grades	TG	121
DATE	REVISION	BY	BRIDGE

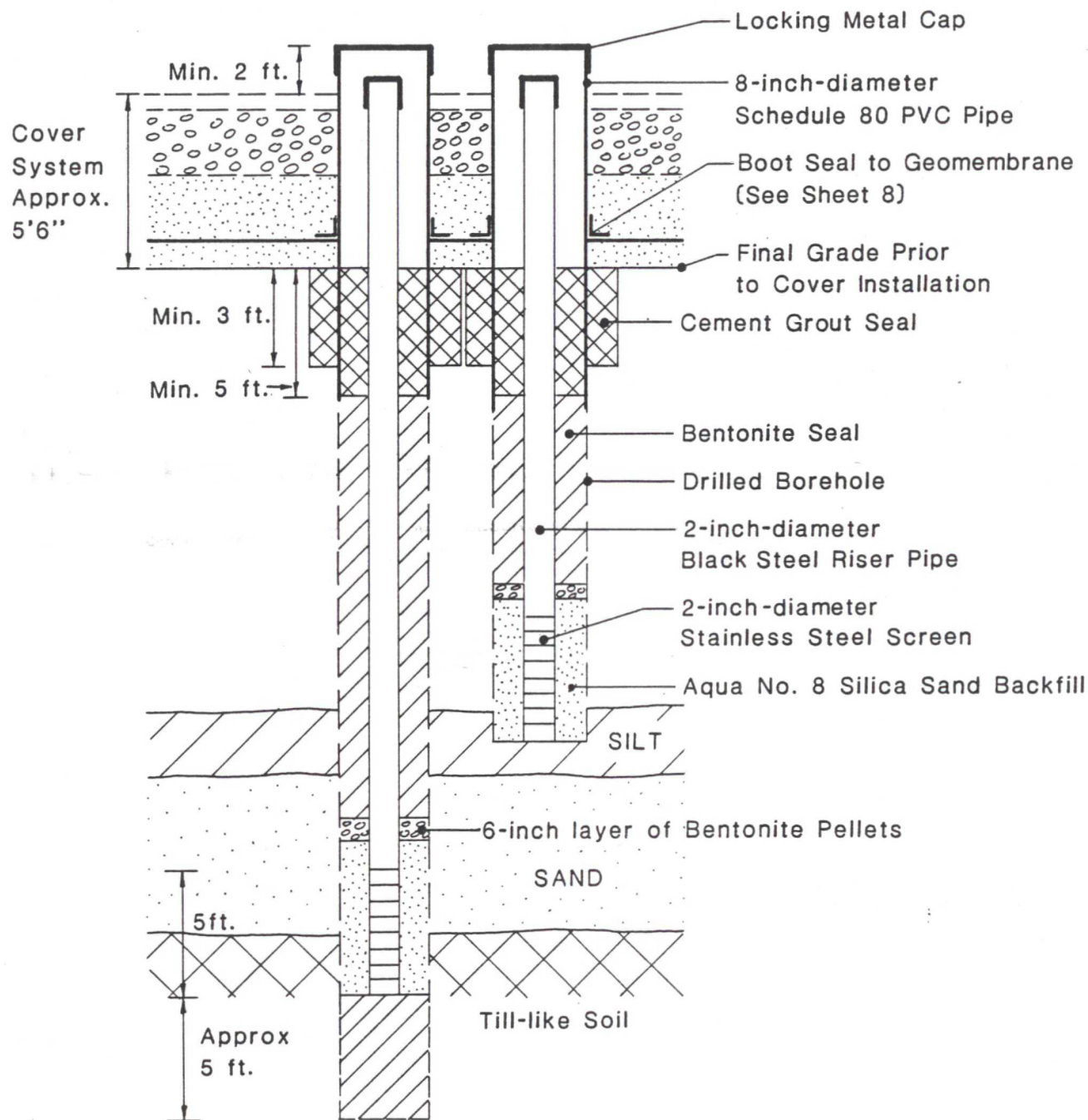
DESIGNED BY: WASHINGTON

DESIGNED BY: WASHINGTON

DESIGNED BY: WASHINGTON

DESIGNED BY: WASHINGTON

Well Construction Features



NOT TO SCALE

J-1264-04 June 1986
HART-CROWSER & associates inc.
Figure 2

Appendix A

Field Exploration Logs

Appendix A includes the interpretive geologic logs for Test Pit excavations TP-101 to TP-106 and Borings HC-14 to HC-24. Soil descriptions were prepared in general accordance with Figure A-1.

Key to Exploration Logs

Sample Descriptions

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:

Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs.

SAND or GRAVEL	Standard Penetration Resistance in Blows/Foot	SILT or CLAY	Standard Penetration Resistance in Blows/Foot	Approximate Shear Strength in TSF
Density		Consistency		
Very loose	0 - 4	Very soft	0 - 2	<0.125
Loose	4 - 10	Soft	2 - 4	0.125 - 0.25
Medium dense	10 - 30	Medium stiff	4 - 8	0.25 - 0.5
Dense	30 - 50	Stiff	8 - 15	0.5 - 1.0
Very dense	>50	Very stiff	15 - 30	1.0 - 2.0
		Hard	>30	>2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

Minor Constituents

Minor Constituents	Estimated Percentage
Not identified in description	0 - 5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Legends

Sampling

BORING SAMPLES

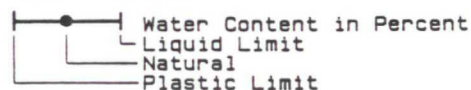
- ☒ Split Spoon
- ☒ Shelby Tube
- ☒ Cuttings
- ☒ Core Run
- * No Sample Recovery
- P Tube Pushed, Not Driven

TEST PIT SAMPLES

- ☒ Grab (Jar)
- ☒ Bag
- ☒ Shelby Tube

Test Symbols

- GS Grain Size Classification
- CN Consolidation
- TUU Triaxial Unconsolidated Undrained
- TCU Triaxial Consolidated Undrained
- TCD Triaxial Consolidated Drained
- QU Unconfined Compression
- DS Direct Shear
- K Permeability
- PP Pocket Penetrometer
- TV Approximate Compressive Strength in TSF
- TV Torvane
- CBR Approximate Shear Strength in TSF
- CBR California Bearing Ratio
- MD Moisture Density Curve
- AL Atterberg Limits



Ground Water Observations

- Surface Seal
- Ground Water Level on Date (ATD) At Time of Drilling
- Observation Well Tip or Slotted Section
- Ground Water Seepage (Test Pits)

Test Pit Log TP-101

Sample	Water Content Percent	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS
				Ground Surface Elevation in Feet 469
S-1	12		0	(Dense to very dense), moist to wet, gray, slightly silty, very gravelly, fine to medium SAND.
S-2	18		1	(Dense to very dense), wet, rusty brown, very sandy GRAVEL with trace to moderate organics.
S-3	14		2	(Dense to very dense), moist to wet, gray-brown, slightly silty, very gravelly, fine to medium SAND.
			3	(Dense to very dense), wet, rusty brown, very gravelly SAND.
S-4	13		4	(Dense to very dense), moist, gray-brown, silty, gravelly to very gravelly, fine to medium SAND with occasional cobbles. (TILL-Like)
			5	Bottom of Test Pit at 6 Feet.
			6	Completed 1/22/86.
			7	Note: Rapid seepage at 1-1/2 and 3-1/2-foot-depths.
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	

Test Pit Log TP-102

Sample	Water Content Percent	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS
				Ground Surface Elevation in Feet 470
S-1	12		0	(Loose to medium dense), wet, brown, slightly silty, gravelly to very gravelly, fine to medium SAND.
S-2	18		1	(Loose to medium dense), moist to wet, brown to rusty brown, slightly silty, gravelly, fine SAND.
S-3	14		2	(Dense), dark brown to rusty brown, slightly silty, very gravelly, fine to medium SAND with moderate to substantial organics and roots.
			3	(Dense to very dense), moist to wet, gray-brown, slightly silty to silty, very gravelly, fine to medium SAND.
S-4	13		4	Grades less silty.
			5	(Dense to very dense), moist, gray-brown, silty, gravelly, fine to medium SAND. (TILL-Like)
			6	Bottom of Test Pit at 8 Feet.
			7	Completed 1/22/86.
			8	Note: Rapid seepage at 2-1/2 and 5-foot-depths.
			9	
			10	
			11	
			12	
			13	
			14	
			15	

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

J-1264-04 January 1986
HART-CROWSER & associates, inc.
Figure A-2

Test Pit Log TP-103

Sample	Water Content Percent	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS
			0	Ground Surface Elevation in Feet 473
S-1	26		1	(Loose to medium dense), rusty brown, wet, slightly silty, gravelly to very gravelly, fine to medium SAND with trace to moderate organics.
S-2	31		2	
S-3	12		3	
			4	(Dense), wet, rusty brown, very gravelly SAND with moderate organics.
			5	(Dense to very dense), moist, gray-brown, silty, gravelly, fine to medium SAND with occasional cobbles. (TILL-like)
			6	Grades to moist, gray-brown, very silty, gravelly, fine SAND with varying amounts of medium to coarse SAND and occasional cobbles. (TILL-Like)
S-4	9		7	
			8	
			9	Bottom of Test Pit at 9 Feet. Completed 1/22/86.
			10	Note: Moderate seepage at 4-foot-depth.
			11	
			12	
			13	
			14	
			15	

Test Pit Log TP-104

Sample	Water Content Percent	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS
			0	Ground Surface Elevation in Feet 479
S-1	23		1	(Loose to medium dense), moist to wet, rusty brown, slightly silty to silty, slightly gravelly, fine to medium SAND with trace organics, roots and local zones of clean SAND.
			2	
			3	
S-2	11		4	(Dense to very dense), wet, rusty brown, slightly silty, very gravelly SAND.
S-3	7		5	(Dense to very dense), moist, gray-brown, very silty, gravelly, fine SAND with varying amounts of medium to coarse SAND and occasional cobbles. (TILL-Like)
			6	
			7	
			8	
S-4	12		9	
			10	Bottom of Test Pit at 9-1/2 Feet. Completed 1/22/86.
			11	Note: Rapid seepage at 4-foot-depth.
			12	
			13	
			14	
			15	

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

J-1264-04 January 1986
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Figure A-3

Test Pit Log TP-105

Sample	Water Content Percent	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS
				Ground Surface Elevation in Feet 481
			0	(Loose to medium dense), moist to wet, brown, slightly silty, gravelly, fine to medium SAND.
S-1	19		1	
			2	(Loose to medium dense), moist-wet, rusty brown, slightly silty, gravelly, fine to medium SAND with trace to moderate organics and roots.
S-2	12		3	
			4	(Dense to very dense), moist, gray-brown, very silty, gravelly, fine to medium SAND with varying amounts of medium to coarse sand and occasional cobbles. (TILL-Like)
S-3	10		5	
S-4	12		6	
			7	
			8	Bottom of Test Pit at 8 Feet. Completed 1/22/86.
			9	Note: Slight seepage at 3-1/2-foot-depth.
			10	
			11	
			12	
			13	
			14	
			15	

Test Pit Log TP-106

Sample	Water Content Percent	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS
				Ground Surface Elevation in Feet 492
			0	(Loose), moist, dark brown, slightly silty, gravelly to very gravelly, fine to medium SAND.
			1	Moderate organics
			2	(Loose to medium dense), moist to wet, rusty brown, slightly silty, gravelly, fine to medium SAND with trace to moderate organics.
S-1	8		3	
			4	(Loose to medium dense), damp, gray, gravelly SAND.
			5	
			6	
S-2	24		7	
			8	(Loose to medium dense), wet, rusty brown to tan, slightly gravelly, silty to very silty, fine SAND.
S-3	14		9	(Medium dense to dense), moist, gray-brown, very silty, gravelly to very gravelly, fine SAND with varying amounts of medium to coarse sand. (TILL-Like)
			10	Bottom of Test Pit at 10 Feet. Completed 1/22/86.
			11	Note: Moderate seepage at 7-foot-depth.
			12	
			13	
			14	
			15	

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

J-1264-04 January 1986
HART-CROWSER & associates, inc.
Figure A-4

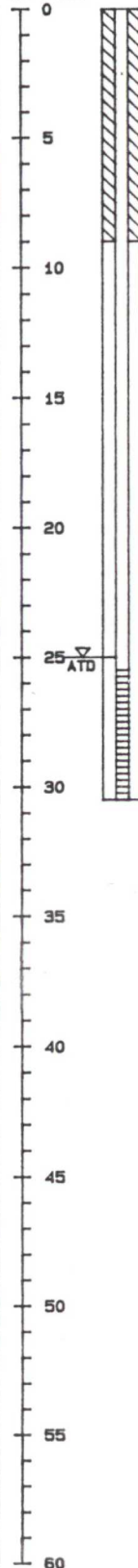
Boring Log HC-14

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet 502

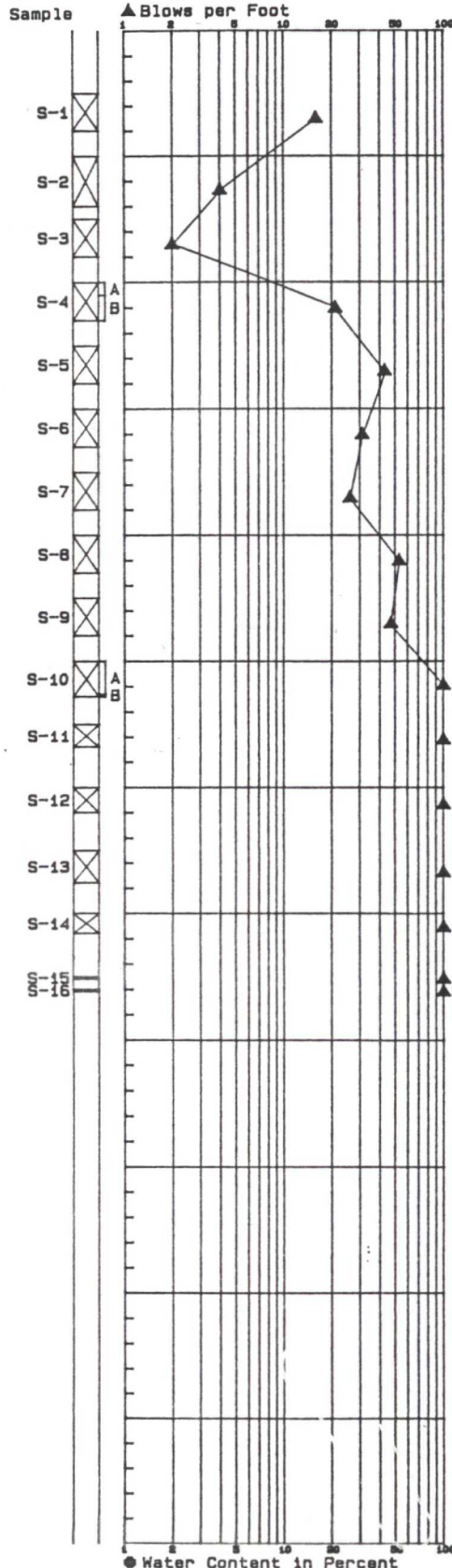
(Medium dense), damp to wet, brown, slightly silty to silty, gravelly SAND. (FILL)
Grades to (very loose), damp, brown, very gravelly SAND with trace wood.
(Medium dense), wet, red, white, brown, and black, slightly silty, very gravelly SAND with moderate fill debris (wood, metal).
(Dense), wet, dark brown to black, sandy GRAVEL to gravelly SAND with trace to moderate cobbles. Black coating on gravels.
Grade to (very dense), wet, brownish gray, slightly silty, gravelly SAND. Black fluid in sample.
(Very dense), wet, brownish gray, slightly silty to silty, gravelly to very gravelly, fine to medium SAND with trace cobbles. (TILL-like)
Grades to slightly gravelly, silty, fine SAND.
Bottom of Boring at 38.1 Feet. Completed 1/10/86.
Note: *Penetration resistance based on 300-pound hammer falling 30 inches.

Depth in Feet



PENETRATION RESISTANCE *

▲ Blows per Foot



H-Nu MEASUREMENT (ppm)

1
1 - 2
1 - 2

93
11"
50
5"
50
6"
97
9"
50
4"
50
3"
50
1"

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1264-04 January 1986
HART-CROWSER & associates, inc.
Figure A-5

Boring Log HC-14A

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet 502

Drilled without sampling to 28 feet.
Refer to log of Boring HC-14 for
soil description to 28 feet.

- Drager tube indicates ~1 to 2 ppm
for hydrogen cyanic acid.

- Large cobbles and gravel encountered.

Bottom of Boring at 28.0 Feet.
Completed 1/13/86.

Note: Boring terminated at refusal.

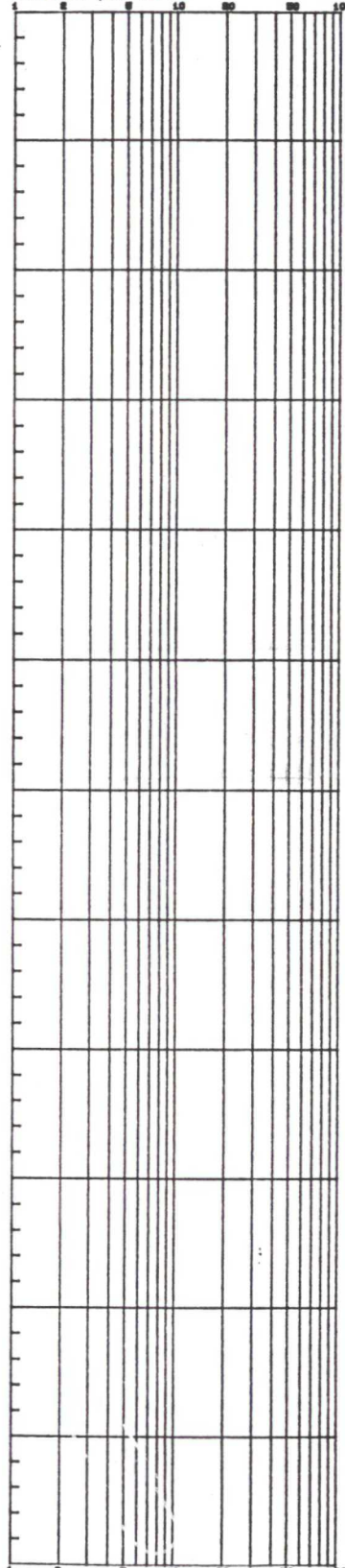
Depth
in Feet

0
5
10
15
20
25
30
35
40
45
50
55
60

Sample

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



H-Nu
MEASUREMENT
(ppm)

1 - 2

1 - 2

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1264-04 January 1986
HART-CROWSER & associates, inc.
Figure A-6

Boring Log HC-14B

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet 502

Drilled without sampling to 16 feet.
Refer to log of Boring HC-14 for
soil description to 16 feet.

- Large cobbles.

Bottom of Boring at 16.0 Feet.
Completed 1/13/86.
Note: Boring terminated at refusal.

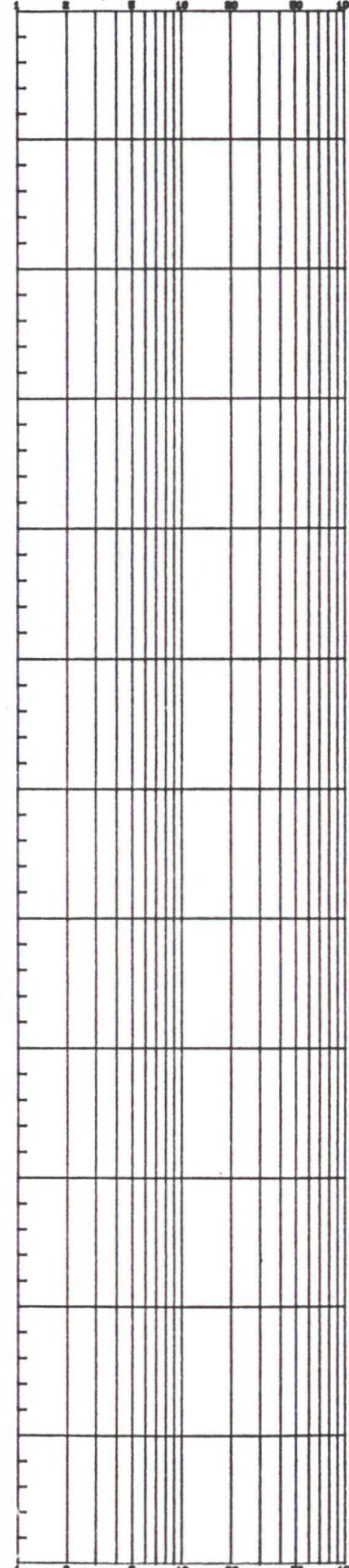
Depth
in Feet

0
5
10
15
20
25
30
35
40
45
50
55
60

Sample

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



H-Nu
MEASUREMENT
(ppm)

1 - 1-1/2

1

1-1/2

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1264-04 January 1986
HART-CROWSER & associates, inc.
Figure A-7

Boring Log HC-14C

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet 503

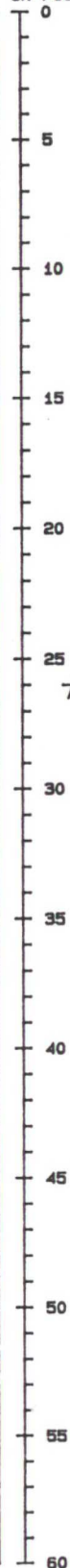
Drilled without sampling to 32.5 feet. Refer to log of Boring HC-14 for soil description to 32.5 feet. Encountered black soils at 2 feet.

(Very dense), wet, brown, silty, gravelly, fine SAND. (TILL-like)

Bottom of Boring at 42.8 Feet. Completed 1/3/86.

Note: *Penetration resistance based on 300-pound hammer falling 30 inches.

Depth
in Feet

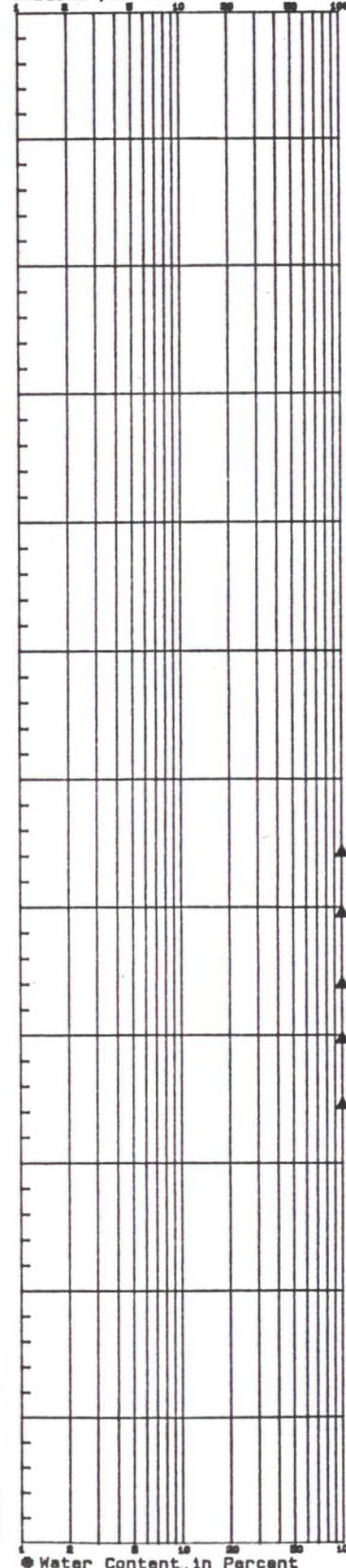


Sample

S-1
S-2
S-3
S-4
S-5
S-6

* PENETRATION RESISTANCE

▲ Blows per Foot



H-Nu
MEASUREMENT
(ppm)

5
1 - 2
1 - 2
2
1 - 2
1 - 2
1

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1264-04 January 1986
HART-CROWSER & associates, inc.
Figure A-8

Boring Log HC-15

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet 500

(Very dense), moist to wet, brown, slightly silty to silty, sandy GRAVEL.

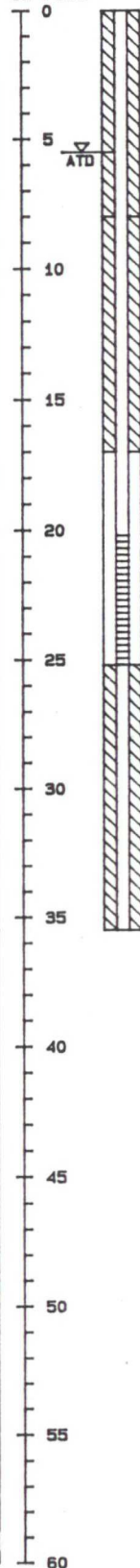
(Very dense), wet, brown, slightly silty to silty, sandy GRAVEL to gravelly SAND. (TILL-like)

Bottom of Boring at 35.5 Feet.
Completed 1/28/86.

H-Nu background measurement ~1 ppm at ground surface.

Piezometer DRY 2/7/86.

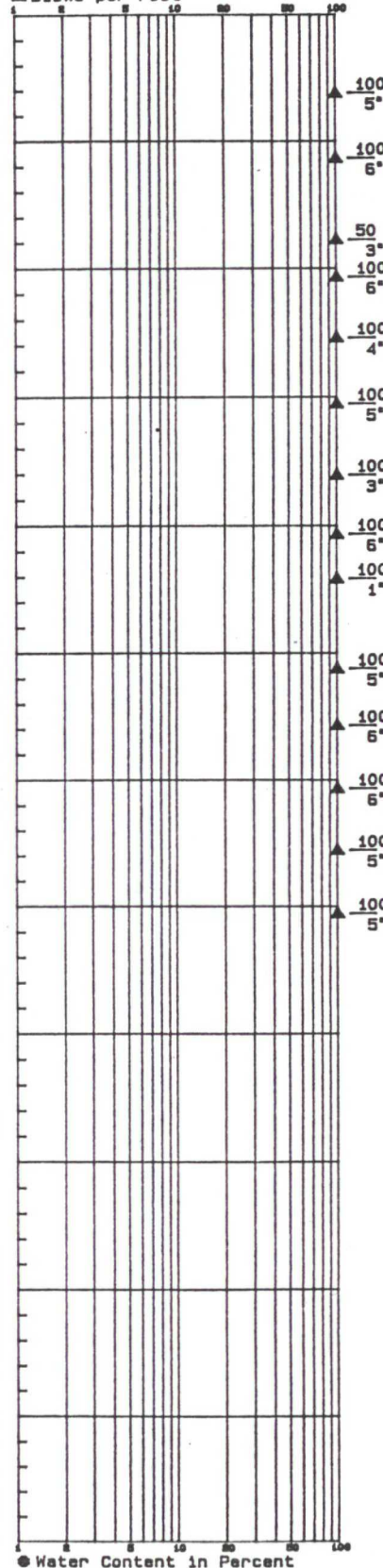
Depth
in Feet



Sample

STANDARD PENETRATION RESISTANCE

Blows per Foot



H-Nu
MEASUREMENT
(ppm)

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1264-04 January 1986
HART-CROWSER & associates, inc.
Figure A-9

Boring Log HC-16

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet 514

(Dense), moist to wet, reddish brown to dark brown, very sandy GRAVEL to gravelly, medium to fine SAND.

(Very dense), moist to wet, brown, silty, very gravelly, medium to fine SAND. (TILL-like)

- Grades to silty, gravelly, fine SAND.

- Grades to moist, gray, silty, sandy GRAVEL.

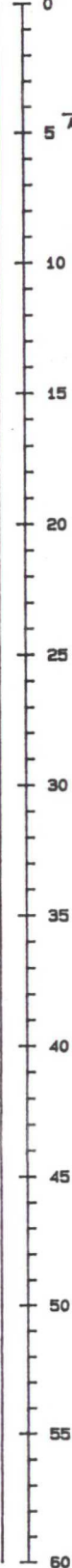
Bottom of Boring at 25.5 Feet.
Completed 1/29/86.

H-Nu background measurement <1 ppm at ground surface.

Note:

Depth to TILL-like surface may be higher than indicated. The presence of gravels and cobbles inhibited sample recovery and visual identification of TILL-like soils in samples S-4 and S-5.

Depth
in Feet

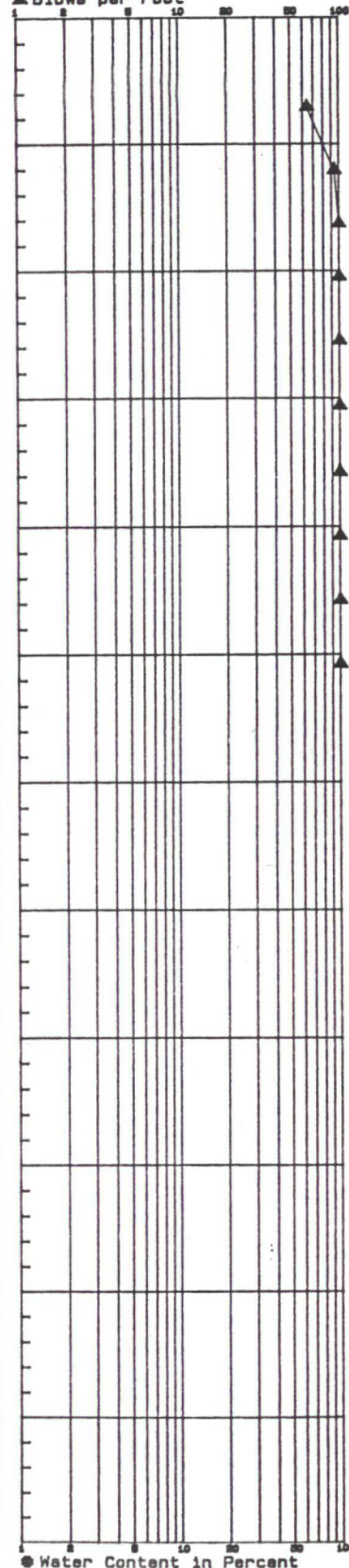


Sample

S-1
S-2
S-3
S-4
S-5
S-6
S-7
S-8
S-9
S-10

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



H-Nu
MEASUREMENT
(ppm)

< 1
< 1
< 1
< 1
< 1
< 1
< 1
< 1
< 1
< 1

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1264-04 January 1986
HART-CROWSER & associates, inc.
Figure A-10

Boring Log HC-17

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet 513

(Dense), moist, brown, very gravelly SAND.

(Dense), moist to wet, brown, silty, gravelly SAND with occasional cobbles. (TILL-like)

- Grades to (very dense), damp to moist, brownish gray.

- Grades to damp to moist, gray, silty, gravelly, medium to fine SAND.

- Grades to wet, gray and brown, silty, very gravelly SAND to very sandy GRAVEL.

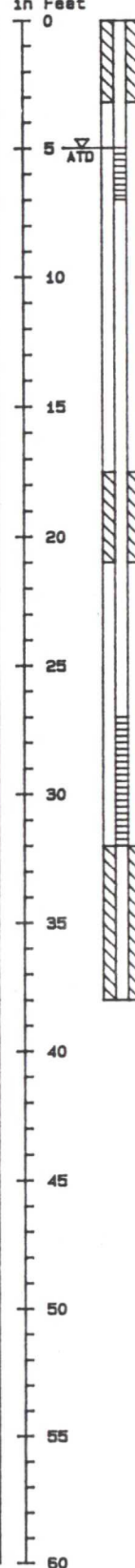
- Grades to moist to wet, brownish gray, silty, gravelly, medium to fine SAND.

Bottom of Boring at 38.0 Feet.
Completed 1/30/86.

H-Nu background measurement <1 ppm at ground surface.

Both piezometers DRY 2/9/86.

Depth in Feet



Sample

S-1

S-2

S-3

S-4

S-5

S-6

S-7

S-8

S-9

S-10

S-11

S-12

S-13

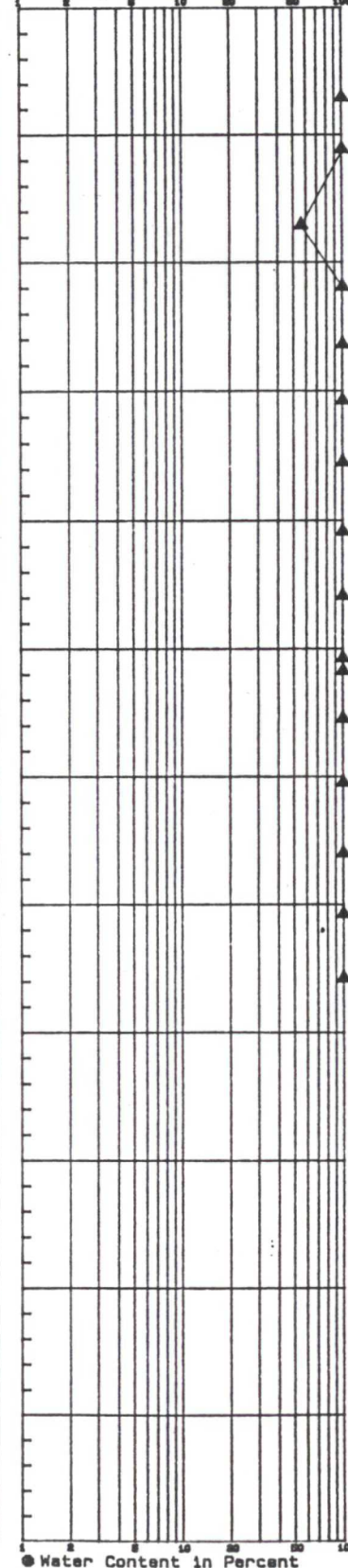
S-14

S-15

S-16

STANDARD PENETRATION RESISTANCE

Blows per Foot



H-Nu MEASUREMENT (ppm)

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1264-04 January 1986
HART-CROWSER & associates, inc.
Figure A-11

Boring Log HC-18

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet 501

(Medium dense), moist to wet, brown and gray, sandy to very sandy GRAVEL.

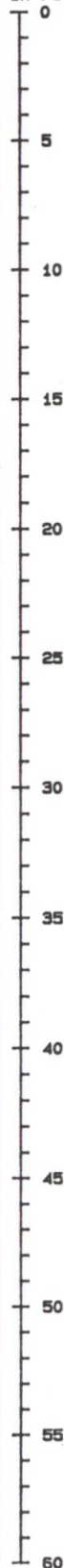
Grades to wet, gravelly, coarse to medium SAND.

Grades to wet, sandy to very sandy GRAVEL.

Bottom of Boring at 21.5 Feet.
Completed 1/31/86.

H-Nu background measurement <1 ppm at ground surface.

Depth
in Feet

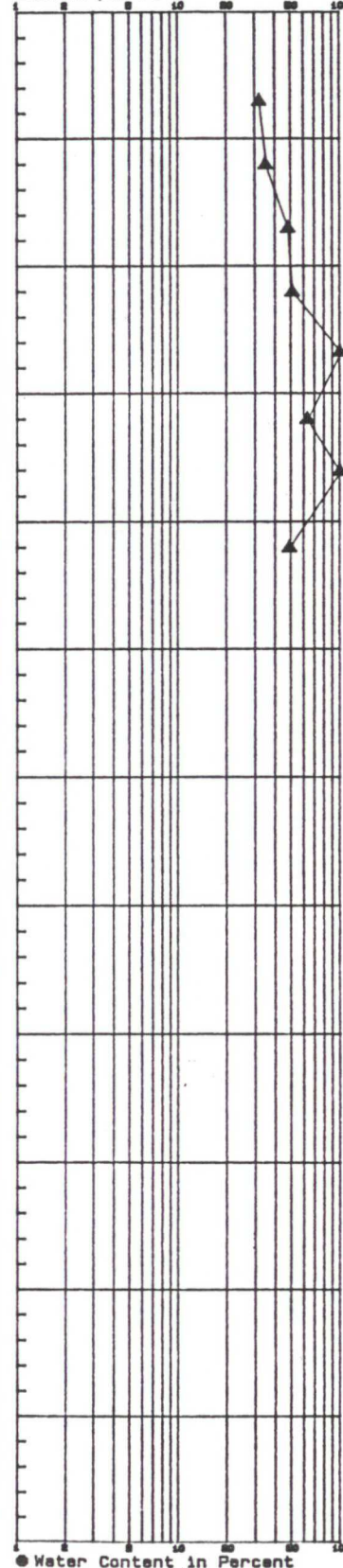


Sample

S-1
S-2
S-3
S-4
S-5
S-6
S-7
S-8

STANDARD PENETRATION RESISTANCE

Blows per Foot



H-Nu
MEASUREMENT
(ppm)

< 1
< 1
< 1
< 1
< 1
< 1
< 1
< 1

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1264-04 January 1986
HART-CROWSER & associates, inc.
Figure A-12

Boring Log HC-19

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet 494

(Medium dense), moist, brown and gray, very gravelly SAND.

Grades to brownish gray, very sandy GRAVEL.

Grades to wet, very gravelly SAND.

Grades to (very dense), wet, brownish gray, slightly silty, very gravelly SAND.

Grades to very sandy GRAVEL.

Grades to moist, very gravelly SAND.

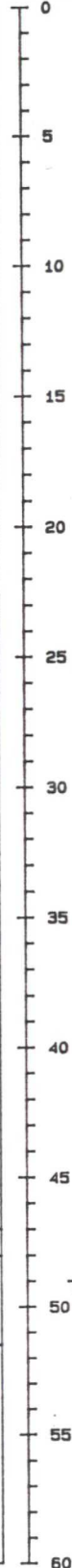
(Stiff to very stiff), moist, brown, sandy SILT.

(Dense), moist, gray, slightly silty, very gravelly SAND to sandy GRAVEL.

(Very dense), damp to moist, brownish gray, slightly gravelly, silty, medium to fine SAND. (TILL-like)

Grades to silty, sandy GRAVEL with occasional cobbles.

Depth in Feet

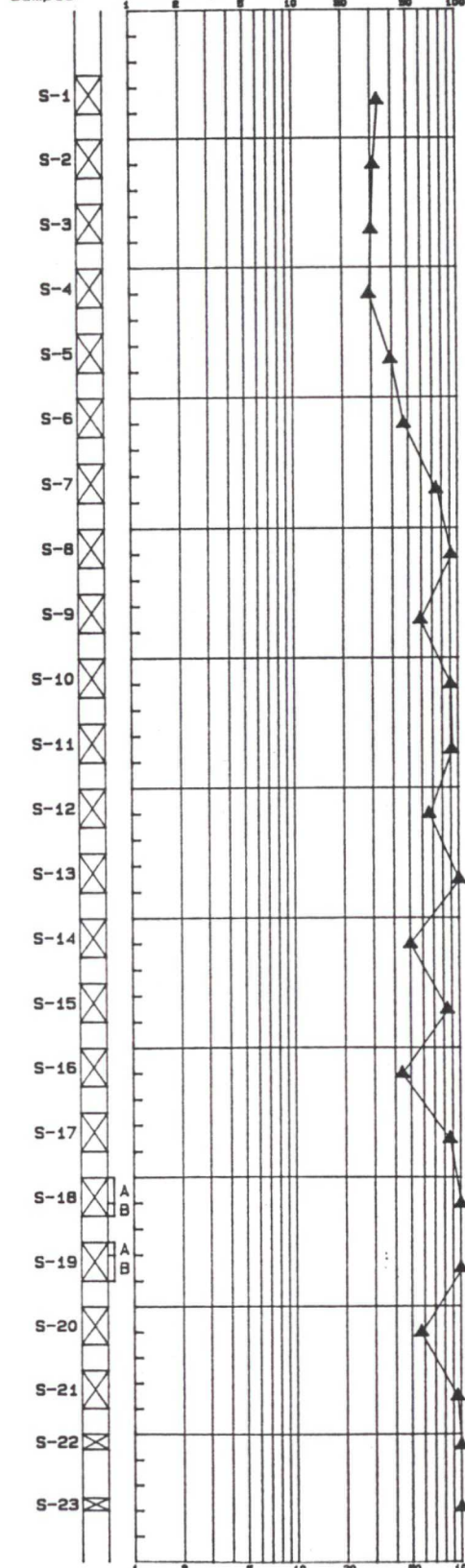


▽
ATD

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot

Sample



H-Nu
MEASUREMENT
(ppm)

< 1

< 1

< 1

< 1

< 1

< 1

< 1

< 1

< 1

< 1

< 1

< 1

< 1

< 1

< 1

< 1

< 1

< 1

6

30

110

5

< 1

< 1

● Water Content in Percent

Boring Log HC-19

SOIL DESCRIPTIONS

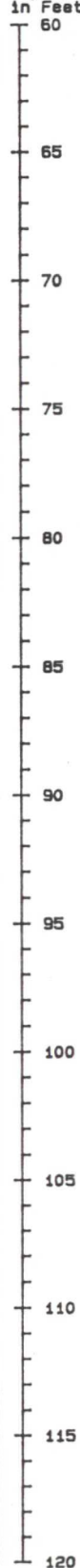
Ground Surface Elevation in Feet 494

(Very dense), moist, brownish gray, silty, sandy GRAVEL with occasional cobbles. Grades to wet, gray, silty, gravelly SAND. (TILL-like)

Bottom of Boring at 65.5 Feet. Completed 2/3/86.

H-Nu background measurement <1 ppm at ground surface.

Depth
in Feet

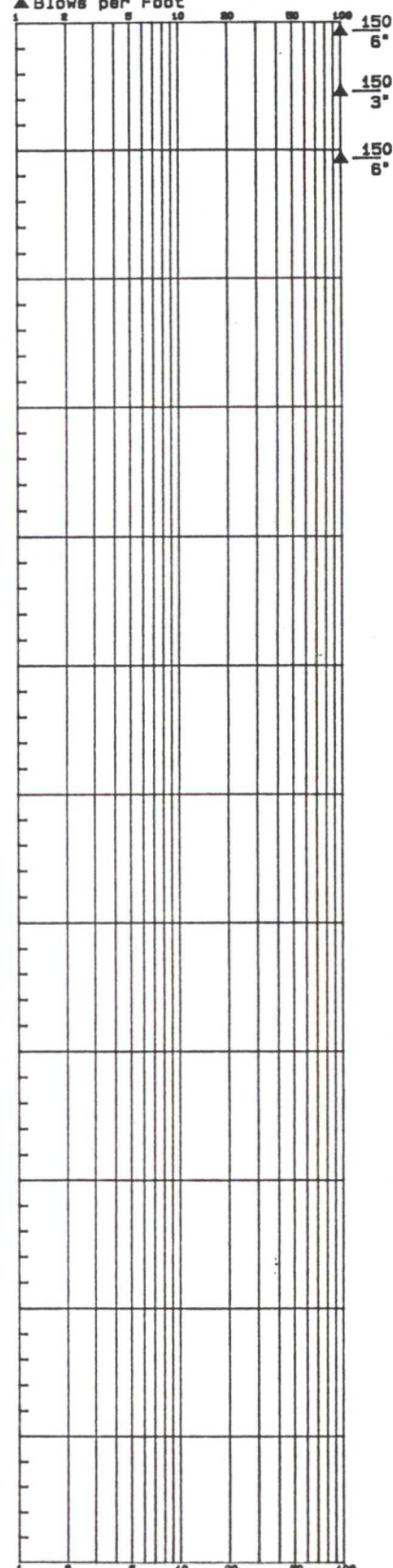


Sample

S-24
S-25
S-26

STANDARD PENETRATION RESISTANCE

Blows per Foot



H-Nu
MEASUREMENT
(ppm)

< 1
< 1
< 1

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.
Sheet 2 of 2 Figure A-13

Boring Log HC-20

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet 504

(Medium dense), moist, brown, slightly silty, sandy GRAVEL.

Grades to (dense to very dense).

Grades to (medium dense), wet, slightly silty, very gravelly SAND.

(Dense to very dense), damp to moist, brown, slightly silty, gravelly SAND. (TILL-like)

Bottom of Boring at 20.3 Feet. Completed 2/4/86.

H-Nu background measurement <1 ppm at ground surface.

Depth in Feet

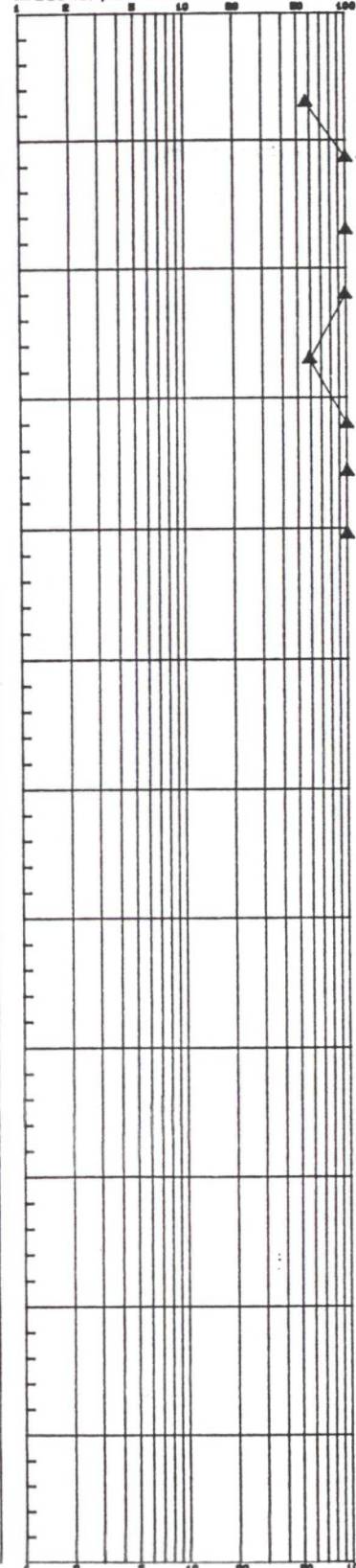


Sample

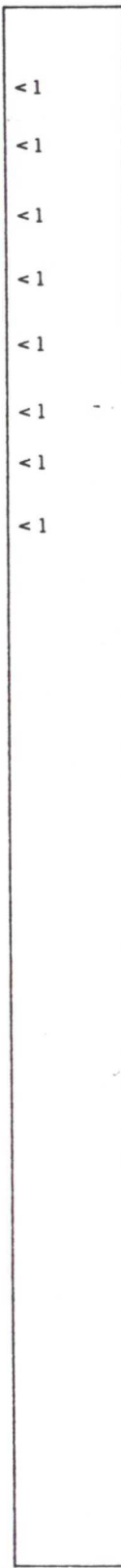


STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



H-Nu MEASUREMENT (ppm)



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1264-04 February 1986
HART-CROWSER & associates, inc.
Figure A-14

Boring Log HC-21

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet 513

(Dense), moist, gray and brown, very sandy GRAVEL with trace cobbles.

Grades to damp to moist, brownish gray, very silty SAND with trace gravel.

Grades to moist to wet, brownish gray, very gravelly SAND to sandy GRAVEL.

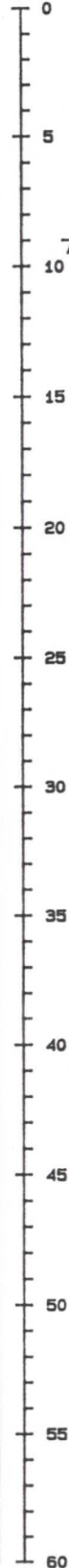
(Very dense), damp to wet, gravelly, very silty SAND. (TILL-like)

Cobbles.

Bottom of Boring at 20.3 Feet. Completed 2/5/86.

H-Nu background measurement <1 ppm at ground surface.

Depth in Feet

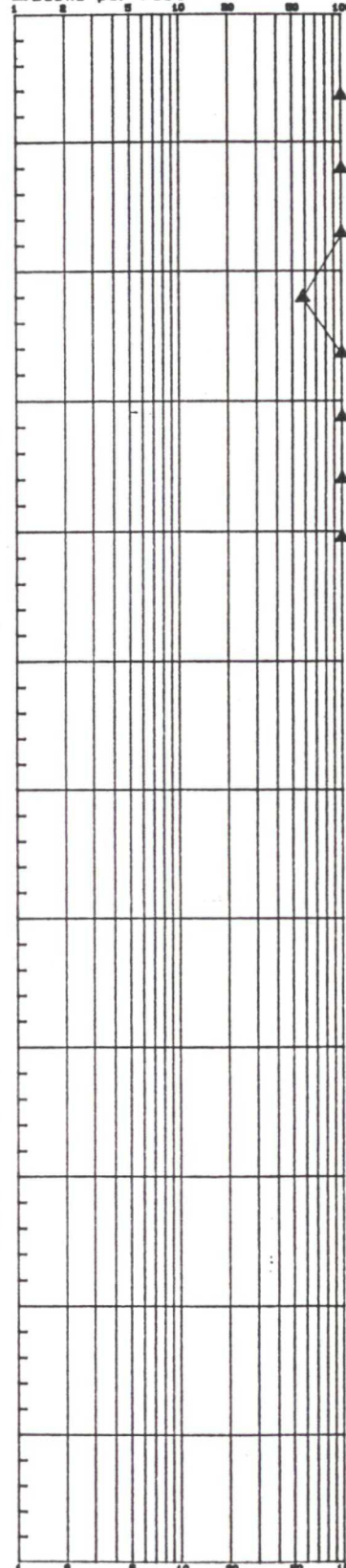


Sample



STANDARD PENETRATION RESISTANCE

Blows per Foot



H-Nu MEASUREMENT (ppm)



Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.
Figure A-15

Boring Log HC-22

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet 509

(Very dense), moist, brown, silty, very gravelly SAND with trace to moderate cobbles.

- Grades to moist, brownish gray, slightly gravelly SAND.

(Very dense), moist, brown, slightly silty, gravelly SAND. (TILL-like)

- Grades to brownish gray, gravelly, very silty SAND.

- Cobbles and boulders.

Bottom of Boring at 19.2 Feet. Completed 2/5/86.

H-Nu background measurement <1 ppm at ground surface.

Depth in Feet

0
5
10
15
20
25
30
35
40
45
50
55
60

Sample

S-1

S-2

S-3

S-4

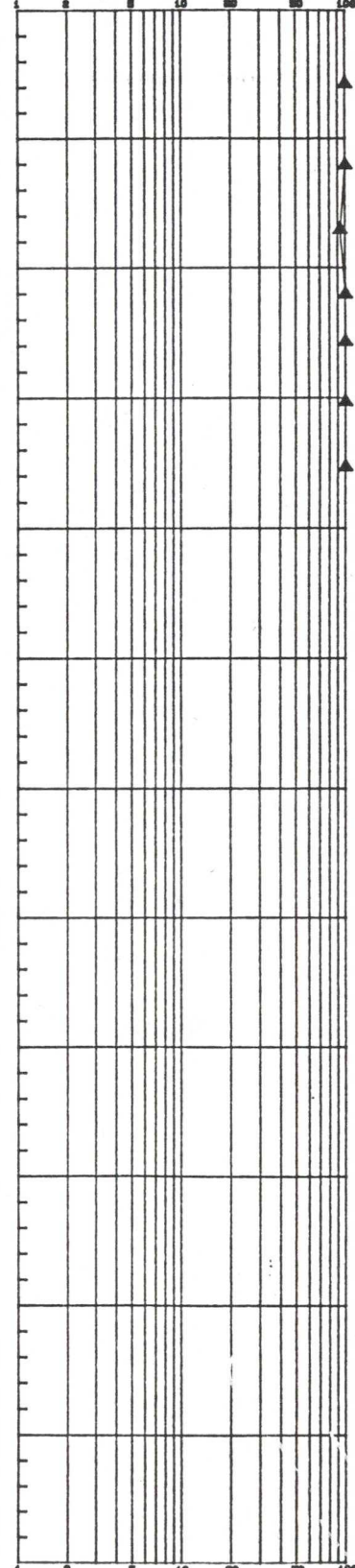
S-5

S-6

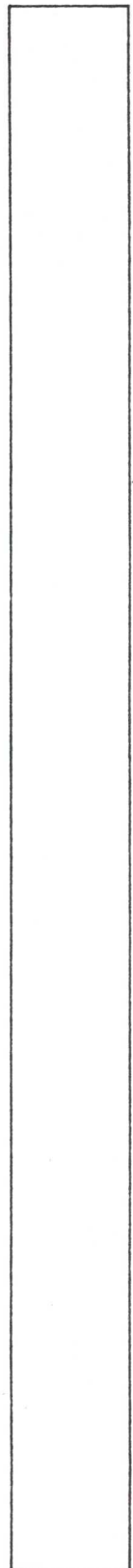
MS-7

STANDARD PENETRATION RESISTANCE

Blows per Foot



H-Nu MEASUREMENT (ppm)



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.
Figure A-16

Boring Log HC-23

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet 483

(Loose to medium dense), damp, brown, silty, sandy GRAVEL and gravelly SAND with trace cobbles.

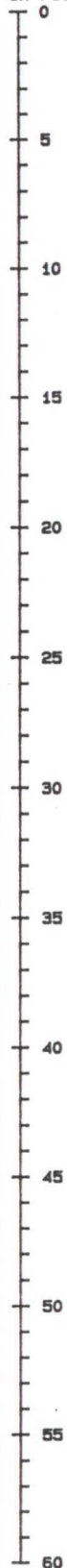
Trace roots.

Grades to (medium dense to dense), damp, gray and brown, slightly silty, sandy GRAVEL to gravelly SAND with trace cobbles.

Bottom of Boring at 21.5 Feet.
Completed 2/7/86.

H-Nu background measurement <1 ppm at ground surface.

Depth
in Feet

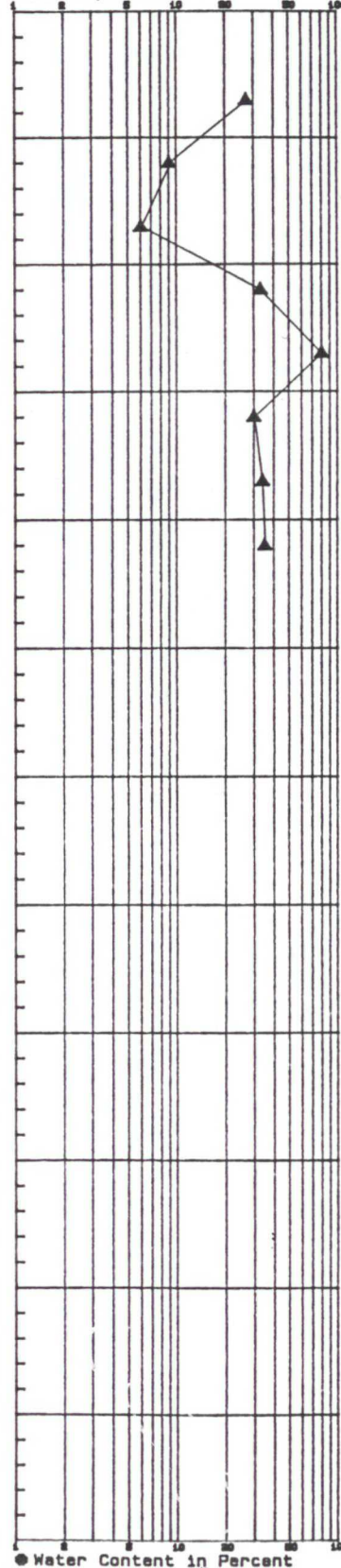


Sample

S-1
S-2
S-3
S-4
S-5
S-6
S-7
S-8

STANDARD PENETRATION RESISTANCE

Blows per Foot



H-Nu
MEASUREMENT
(ppm)

<1
<1
<1
<1
<1
<1
<1
<1

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.
Figure A-17

Boring Log HC-24

SOIL DESCRIPTIONS

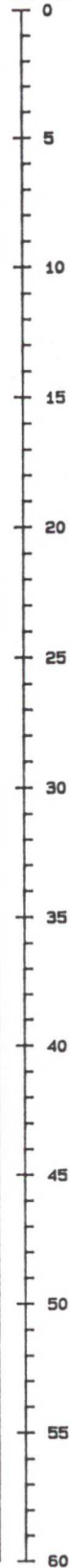
Ground Surface Elevation in Feet 489

(Loose to medium dense), moist, brown, silty, sandy GRAVEL and gravelly SAND with trace cobbles.

Bottom of Boring at 17.5 Feet.
Completed 2/7/86.

H-Nu background measurement <1 ppm at ground surface.

Depth
in Feet

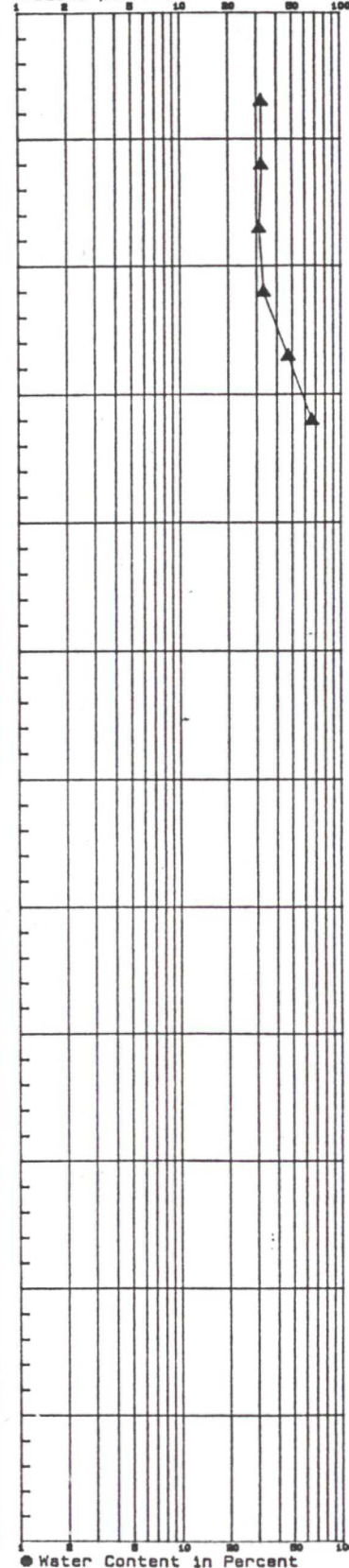


Sample

S-1
S-2
S-3
S-4
S-5
S-6

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



H-Nu
MEASUREMENT
(ppm)

<1
<1
<1
<1
<1
<1

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1264-04 February 1986
HART-CROWSER & associates, inc.
Figure A-18

Appendix B
Geomembrane Subcontractor
Technical Specifications

J-1264-04

APPENDIX B

GEOMEMBRANE SUBCONTRACTOR TECHNICAL SPECIFICATIONS

1.00 Scope of Construction

The geomembrane subcontractor will be responsible for supplying the following:

- o The 30-mil nominal thickness PVC geomembrane for the final cover and diversion trench.
- o The cushioning geotextile for the diversion trench.
- o The "boot connections" between the geomembrane and monitoring wells.

The geomembrane subcontractor will be responsible for installing the following:

- o The geomembrane and cushioning geotextiles in the upgradient diversion trench.
- o The geomembrane and overlying soil layers for the final cover (including soil backfill in the diversion trench excluding pea gravel backfill).
- o The connecting seams required for the geomembrane in the diversion trench and the final cover geomembrane.
- o "Boot connections" between monitoring wells and final cover.
- o Final cover drain system (including grate inlet, perforated piping and cleanouts) and east toe drain system.

- o "Ditch-witch" trenches and hand compaction of silt against geomembrane.

The geomembrane subcontractor will also be responsible for quality assurance and construction quality control for his work.

NWES will be responsible for supplying the following materials:

- o All earth materials (including sand, cobbles, sand and gravel);
- o All pipe and other drainage material (including grate inlets).

NWES will be responsible for the following activities at the upgradient diversion trench that will require coordination between the subcontractor and NWES.

- o Excavation of trench prism,
- o Placement of diversion system pipe and manholes,
- o Placement of pea gravel backfill,
- o Placement of filtering geotextile,
- o Placement of compacted silt dam.

The subcontractor and NWES shall agree upon the width of geomembrane panels to be used in the diversion trench construction.

2.00 Subcontractor Selection

The geomembrane subcontractor will be selected by NWES on the basis of the following information:

- o Subcontractor's experience in installing PVC geomembrane and the overlying soil layers;
- o Subcontractor's ability to perform the work outlined by the plans and specifications;

- o Subcontractor's cost estimate for performing the required work;
- o Subcontractor's estimated time of initiation and completion of construction relative to a notice-to-proceed.

To be considered for this work, the subcontractor is required to submit the following information:

- o List of projects in which 30-mil PVC was installed by the subcontractor;
- o List of references (owners or engineers) familiar with the subcontractor's performance (with respect to above projects);
- o A bid estimate for the work to be done (including unit prices and quantities);
- o Firm dates for the earliest delivery of materials and completion of installation with respect to a notice-to-proceed;
- o A statement saying that the subcontractor is familiar with the plans and specifications and that it is his professional opinion that the design will meet the intent of the project and that he can construct the facilities to achieve that design. The subcontractor must also provide information regarding chemical additives to the geomembrane (such as plasticizers) discussing the appropriate selection of such additives for this project;
- o A statement noting warranties provided for the geomembrane installation by the manufacturers, fabricator, and installer. The statement should clearly point out the responsibilities for costs incurred in replacement or repair during construction, at the completion of construction and at some time after the completion of construction.

3.00 Acceptance and Responsibility

The subcontractor shall observe and accept the condition of the silt layer subgrade prior to the geomembrane installation for the final cover. Any modifications to the subgrade will be made by NWES.

The subcontractor shall accept full responsibility for the installation of the geomembrane in the diversion trench and final cover and the overlying soil layers and drainage systems of the final cover. The subcontractor is responsible for storage, handling, and installation of the geomembrane which shall be in accordance with the manufacturer's recommendations.

4.00 Geomembrane Material

The 30-mil PVC sheeting shall meet or exceed the material properties for unsupported PVC as given in Table 1A of the National Sanitation Foundation (NSF) Standard Number 54 for Flexible Membrane Liners (as revised November, 1985). Factory seams shall meet the requirements stated in NSF Standard Number 54.

The subcontractor is responsible for providing test data acceptable to NWES that indicates the above requirements are met for the materials to be used on this project. The subcontractor shall be responsible for the accomplishment of a representative number of tests to document the above requirements were met. The subcontractor is also responsible for providing data demonstrating the prescribed composition of the geomembrane (e.g. plasticizer) was utilized.

5.00 Pre-Construction Meeting

The construction of these facilities will require close coordination between the subcontractor and NWES. Prior to construction, and once the start date of construction is set, a pre-construction meeting will be held to coordinate activities.

6.00 Installation

The subcontractor shall install the geomembrane and associated geotextiles in accordance with the manufacturer's recommendations particularly with reference to wind, temperature, and ultraviolet exposure.

The subcontractor shall employ field seaming methods for the geomembrane that will achieve the quality of factory seams as required by NSF Standard 54. In addition, the seaming technique shall not allow wrinkles or "fish mouths", and shall provide a 100 percent sealed area between two sheets of geomembrane material.

The material in the area of seams shall be free of moisture, dust, soil, or other deleterious material. Accordingly, the seams shall be accomplished in conditions that are suitable for that technique of seaming. A minimum of 2 inches overlap shall be provided for the seam.

The field seams shall be tested as described in Section 7.00.

The subcontractor shall select a method for placing soil layers above the geomembrane that does not damage the geomembrane, and shall specifically avoid allowing soil materials to slide or flow on top of the geomembrane. The geomembrane subcontractor is responsible for achieving the thickness of soil layers shown on the plans. NWES will provide the quantities of soil required for the soil cover. The geomembrane subcontractor is responsible for demonstrating that he has constructed the soil layers without damaging the geomembrane as specified in Section 7.00.

The subcontractor is also responsible for installing a "boot connection" between the geomembrane and protruding PVC monitoring well protective casing. The same quality control requirements and testing for seams apply to the connection of the boot to the protective casing and to the geomembrane. The boot connection shall also be PVC and be no thinner than the geomembrane.

Installation of the flexible pipe cover drains is also the responsibility of the subcontractor. The installation includes all connections and catch basins. Refer to Sheet 2 for the plan view and Sheets 7 and 8 for Typical Sections.

The subcontractor is responsible for submitting his proposed technique for installing the geomembrane and final cover (including equipment types).

7.00 Quality Assurance and Quality Control (QA/QC)

7.01 Factory QA/QC

The subcontractor is responsible for assuring that factory manufacturing methods will produce a sheet that will meet or exceed the requirements of NSF Standard 54. The subcontractor shall submit for NWES approval a factory testing procedure and frequency of the testing for the sheeting. The subcontractor shall also provide factory testing procedures/frequency of the factory seams. All factory seams (100 percent of their length) shall be tested for their integrity using vacuum testing, air lance testing, or other methods acceptable to NWES.

The subcontractor shall also provide data demonstrating that the prescribed composition of the PVC sheet (see Section 2.00 of this Addendum) was accomplished (e.g. plasticizers).

The results of the factory QA/QC testing shall be provided to NWES for their review prior to use of material at the site.

7.02 Field QA/QC

The subcontractor shall be responsible for field QA/QC of the geomembrane and overlying soil layer installation. The subcontractor shall have a full-time QA/QC representative to be responsible for the following:

- o Daily test seams for destructive testing. These seams should be large enough to allow for bonded seam strength and peel adhesion testing on-site and allow for additional independent tests if necessary. The test results shall meet or exceed those given in NSF Standard 54 for factory seams.

Daily test seams shall be prepared each 100 lineal feet of diversion trench and each 5,000 square feet of final cover. The testing frequency of the daily test seams shall be determined on the basis of initial test results and may not require all test seams to be destructively tested.

- o Seam integrity testing of 100 percent of all field seams. Vacuum testing, air lance testing, or other methods agreed upon by NWES, Hart Crowser, and the subcontractor shall be used.
- o Daily record keeping of the geomembrane construction including daily progress, the personnel and methods used, testing and/or repairs accomplished.
- o The excavation and observation for defects of a fully-completed cover section. This test section represents a small portion of the actual cover and should be accomplished prior to production installation so that changes to procedure can be made if necessary. The excavation of soil layers shall be accomplished carefully by the subcontractor at a location selected by NWES to observe the effect of soil layer construction methods on the geomembrane. The size of the section to be excavated shall be no smaller than 10 feet by 10 feet and shall include a field seam. It may be necessary to construct a section larger than 10 feet by 10 feet to fully model construction procedures.

In the event the daily test seams fail the minimum test criteria, the remaining test seam or cut-portions of in-place seams shall be tested. Should those fail, the subcontractor is responsible for replacing that length of seam represented by the daily test seam. The testing of the

daily test seam shall occur as quickly as feasible after seaming. The daily test seam shall be made under the same conditions as the production seams.

In the event the geomembrane in the excavated test section is damaged by holes, rips, tears, or other defects, the subcontractor shall be responsible for repairing that section of geomembrane and for modifying proposed construction techniques and/or additional test sections.

All costs for the quality assurance/quality control program including testing (field and laboratory) of the geomembrane, excavating of test section, and repairs of the geomembrane or soil layers shall be borne by the subcontractor and shall be included in his bid for this work.

Appendix C

**Hydroseed Subcontractor
Technical Specifications**

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APPENDIX C

HYDROSEEDING SUBCONTRACTOR TECHNICAL SPECIFICATIONS

1.00 Scope

The hydroseeding subcontractor will be responsible for applying seed, fertilizer, mulch, and soil binder or tacking agents to all graded and disturbed areas and to other areas designated by Northwest EnviroService, Inc. (NWES).

2.00 Subcontractor Selection

The subcontractor shall observe the project site and take soil samples prior to submitting a bid to NWES. The soil samples shall be used as the basis for recommending any modifications to the specified seeding, fertilizing, and mulching rates.

The hydroseeding subcontractor will be selected by NWES on the basis of the following information which shall be submitted in writing by the subcontractor:

- o Subcontractor's experience and references on similar projects in the Puget Sound Region;
- o Subcontractor's unit prices for performing the specific work;
- o Subcontractor's recommendations on any modifications to the specified seeding, fertilization, and mulching rates and unit prices for performing the modified work;

- o Subcontractor's estimated time for starting and completing work relative to a notice-to-proceed;
- o Subcontractor's guarantee for growing grass on the hydroseeded areas and the subcontractor's responsibilities within one year after hydroseeding.

3.00 Standard Specifications

Hydroseeding shall be accomplished in accordance with the requirements of Sections 8-01 and 9-14 of the 1984 APWA Standard Specifications as modified herein.

4.00 Submittals

The subcontractor shall submit copies of the following data to the NWES for review and approval prior to hydroseeding:

- o Selected seed mix, fertilizer, mulch and application rules;
- o Catalogue data on fertilizer, mulch and any other materials that will be applied to the project site such as binding and tacking agents.

5.00 Materials

A. Materials shall meet the requirements of the following listed sections of the Standard Specifications plus the amendments described after the following list.

Seed	9-14.2
Fertilizer	9-14.3
Mulch (wood cellulose fiber)	9-14.4(2)

B. Seed

The seed mixture shall produce a shallow-rooted grass able to survive in this environment. The seed mixture shall be submitted for review.

C. Fertilizer

Fertilizer shall be a standard commercial grade or organic or inorganic fertilizer of the kind and quality specified herein. It may be separate or in a mixture containing the percentage of total nitrogen, available phosphoric acid, and water-soluble potash in the amounts specified. All fertilizers shall be furnished in standard unopened containers with weight, name of plant nutrients, and manufacturer's guaranteed statement of analysis clearly marked, all in accordance with State and Federal laws.

Acceptable commercial fertilizer may be supplied in one of the following forms:

- 1) A dry free-flowing granular fertilizer suitable for application by agricultural fertilizer spreader.
- 2) A soluble fertilizer ground to a fineness that will permit complete suspension of insoluble particles in water, suitable for application by power sprayer.
- 3) A granular or pelleted fertilizer, suitable for application by blower equipment.
- 4) A non-volatile liquid fertilizer.

Fertilizer shall be standard commercial grade 10-20-20 formulation. Fifty percent of the nitrogen shall be derived from 38 percent ureaformaldehyde.

D. Asphalt Emulsion

Asphalt emulsion will not be accepted.

E. Soil Binder or Tacking Agent

Soil binders and tacking agent materials will require approval by the NWES.

6.00 Construction Requirements

- A. The subconsultant shall meet the requirements of the following listed sections of the 1984 APWA Standard Specifications plus the amendments described after the following list:

Seeding	8-01.3(4)A
Fertilizing	8-01.3(4)B
Mulching	8-01.3(5)
Soil Binder or Tacking Agent	8-01.3(6)B
Dates for Application of Seed, Fertilizer, & Mulch	8-01.3(7)
Protection and Care of Seeded Areas	8-01.3(9)
Inspection	8-01.3(10)

B. Seeding

The seed mixture shall be applied at the rate of 100 pounds per acre.

C. Fertilizing

Fertilizer shall be applied at the rate of 500 pounds per acre.

D. Mulching

Section 8-01.3(5) of the 1984 APWA Standard Specification shall be amended to include:

All seeded areas shall be mulched in conjunction with or immediately after application of seed and fertilizer. Mulching material shall be wood cellulose fiber. Rate of application shall be 2,000 pounds per acre.

E. Inspection

Section 8-01.3(10) of the 1984 APWA Standard Specification shall be amended to include:

Seeding will be considered as acceptable only after the growth of uniform, dense grass over the entire seeded area. Any areas which are not completely covered with uniform, dense grass or with grass which is damaged through any cause shall be reseeded at no additional cost.

Partial payment of 70 percent of the unit price bid will be made after the seed, fertilizer, and mulch coverage has been measured for payment. The remaining 30 percent will be paid after grass growth has been accepted.

F. Equipment Access

Vehicles will not be allowed where ground surface slopes exceed 10 percent and in other areas that may be designated by Northwest EnviroServices, Inc.

7.0 Measurement

The area of hydroseeding shall be measured by ground slope area in acres to the nearest hundredth of an acre of actual hydroseeding coverage that is completed and accepted in accordance with these specifications and plans.

8.0 Payment

Hydroseeding shall be paid for at the applicable unit price bid which shall be full compensation for all labor, equipment, and materials necessary for seeding, fertilizing, mulching, applying soil binder or tacking agent, protecting the hydroseeded areas, reseeding, refertilizing, remulching and

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other work necessary to establish a growth of grass that is acceptable to Northwest EnviroService, Inc. Partial and final payment shall be made as previously described in section 6.00(E) of this specification.